
5.0 CUMULATIVE IMPACTS

The Elko Field Office of the BLM is currently preparing three EISs for mining operations within their jurisdiction. These documents are this Betze Project Supplemental EIS, Newmont Gold Company's SOAPA EIS, and Newmont Gold Company's Leeville Project EIS. During the preparation of these three EISs, the BLM determined the potential exists for cumulative environmental impacts associated with the ground water pumping and water management operations of these mines. To facilitate preparation of these EISs, the BLM directed the three third-party EIS contractors to cooperatively prepare a CIA report to address potential cumulative dewatering and discharge impacts for all three mine projects. This report, *Cumulative Impact Analysis of Dewatering and Water Management Operations for the Betze Project, South Operations Area Project, and Leeville Project* (BLM 2000b), is available for review at the BLM Elko Field Office.

This section summarizes the potential cumulative impacts to environmental resources associated with the Goldstrike, Gold Quarry, and Leeville mines in the case of ground water drawdown, and the Goldstrike, Gold Quarry, Leeville, and Lone Tree mines in the case of dewatering discharge to the Humboldt River, as described in the CIA report (BLM 2000b). In addition, the BLM considered the potential effects of other past, present, and reasonably foreseeable future actions that may potentially affect ground water and surface water resources within the area of potential effect, including the Humboldt River.

Resources addressed in this cumulative analysis include geology, ground and surface water resources, riparian areas and wetlands, terrestrial wildlife, aquatic habitat and fisheries, special status species, livestock grazing, socioeconomics, and Native American religious concerns.

The cumulative impacts identified in this SEIS and in the CIA report (BLM 2000b) are associated with Barrick's dewatering and water management operations. No cumulative impacts have been identified relative to the Proposed Action (i.e.,

buried pipeline) and the No Action Alternative analyzed in this SEIS.

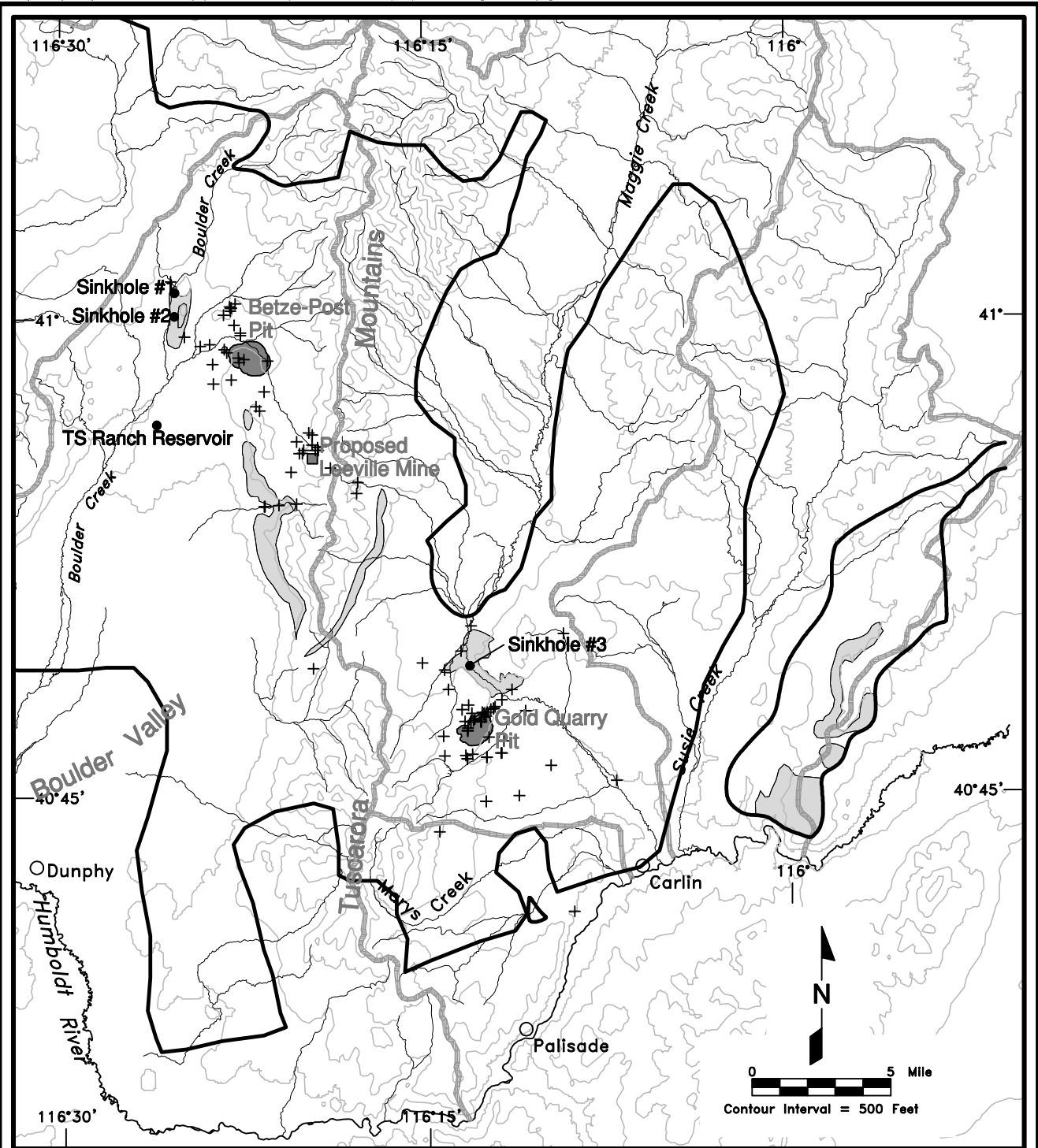
5.1 Geology

5.1.1 Mine Dewatering and Localized Water Management Activities

The primary issue identified for this assessment of cumulative geologic impacts is the potential for development of sinkholes or other karst-type collapse features that could result from mine-induced drawdown and water management activities. Three sinkholes have been documented to-date in the area since dewatering operations were initiated at the Goldstrike and Gold Quarry mines: (1) a sinkhole approximately 3.5 miles northwest of the center of the Betze-Post Pit, (2) a sinkhole approximately 2.8 miles west of the center of the Betze-Post Pit located near spring 6, and (3) a sinkhole along Maggie Creek in an area referred to as the Maggie Creek Narrows.

The criteria described previously in Section 3.1.2.1, were combined with available information on the geology in the region (including location of carbonate outcrop areas and materials above the carbonate rocks), and prediction of ground water drawdown to develop a map (Figure 5-1) illustrating areas that could potentially be susceptible to sinkhole development. The areas where carbonate rocks are located at or near the surface, and assumptions of overburden materials (alluvium or insoluble bedrock) were based on available regional geologic information (Maurer et al. 1996; Newmont 1998). The general depth to the carbonate rocks was based on available well completion logs for monitoring wells completed by Barrick and Newmont.

The results of this evaluation delineate several areas that could potentially be susceptible to sinkhole development. As illustrated in Figure 5-1, areas potentially susceptible to sinkhole development include the large area underlain by carbonate rock located between the Betze-Post Pit and Gold Quarry Pit, the area northwest of the Betze-Post Pit, the Maggie Creek area located north of the Gold Quarry Pit,



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


-  Ground Water Basin Boundary
-  Stream
-  Cumulative Drawdown Area (≥ 10 Feet of Drawdown)
-  Well Used to Define Depth to Limestone
-  Areas that Could Potentially be Susceptible to Sinkhole Development
-  Areas Unlikely to be Impacted by Sinkhole Development

Figure 5-1

Areas Potentially Susceptible to Sinkhole Development

and an area located west of the Gold Quarry Pit. These areas contain few buildings, major roads, or other infrastructure, critical mine-related facilities such as waste rock storage facilities, heap leach pads, and mill and tailings facilities are not located within these areas. A segment of a power line associated with the Carlin Mine occurs within an area that could be susceptible to karst development. Other non-mine-related features of note located within these areas include a 1-mile segment of Boulder Creek, a 1-mile segment of Sheep Creek, a 2.5-mile segment of Maggie Creek, several springs and intermittent streams, a corral, and several unpaved dirt roads.

5.1.2 Humboldt River

No cumulative geologic impacts are anticipated to the Humboldt River as a result of increased or decreased river flows or dewatering.

5.1.3 Proposed Action and No Action Alternative

No cumulative geologic impacts are anticipated from the Proposed Action or No Action Alternative.

5.2 Water Resources and Geochemistry

The following discussion summarizes the cumulative impacts to water resources presented in the CIA report (BLM 2000b). Primary issues addressed in this analysis of cumulative impacts to water resources include the following:

- Reduction in surface and ground water quantity for current users and water-dependent natural resources due to pit dewatering and water management activities
- Impacts to flow in the Humboldt River from direct mine discharge, mine-induced drawdown and mounding, and projected irrigation withdrawals and return
- Impacts to surface water quality from mine water management, including impacts to Humboldt River water quality

- Potential increases in flooding, erosion, and sedimentation associated with water management activities
- Potential changes in the water balance of the hydrologic study area resulting from the existing and proposed mining activities

For the evaluation of cumulative impacts to water resources, the affected environment consists of two study areas: (1) a hydrologic study area for mine dewatering (and localized water management activities), and (2) a Humboldt River study area for evaluating potential effects associated with discharge of excess mine water to the river system.

The cumulative hydrologic study area for mine dewatering encompasses approximately 2,060 square miles and includes six designated ground water basins established by the Nevada Division of Water Resources (Figure 3.2-1). These ground water basins, state identification numbers, and land surface areas are listed in Table 3.2-1. All of these ground water basins drain southward to the Humboldt River. The affected environment for the hydrologic study area for mine dewatering is summarized in Section 3.2.1.2.

The cumulative Humboldt River study area consists of the Humboldt River and its floodplain extending from the USGS gage at Carlin to the Humboldt Sink downstream of Lovelock (Figure 1-6). Quantitative assessments have been conducted for the river from Carlin to the USGS gage at Comus, approximately 9 miles east of Golconda. The Comus gage is approximately 1 mile downstream of the Lone Tree Mine discharge point and reflects the cumulative discharge from the Goldstrike, Gold Quarry, Leeville, and Lone Tree mines. Semi-quantitative or qualitative assessments have been conducted from Comus to the Humboldt Sink. The affected environment for the Humboldt River study area is summarized in Section 3.2.1.3.

The cumulative impact analysis for water resources and geochemistry is subdivided into two primary sections. Section 5.2.1 describes potential cumulative impacts associated with ground water drawdown and mounding from past, present, and future dewatering activities (and other local water management activities) at the

Goldstrike Mine, Gold Quarry Mine, and proposed Leeville Mine located along the Carlin Trend. Section 5.2.2 describes potential cumulative impacts associated with mine discharges to the Humboldt River. The Humboldt River evaluation considers potential effects between the USGS gage near Carlin and the Humboldt Sink downstream. The analysis considers effects of historic and future discharges from the Goldstrike Mine, Gold Quarry Mine, proposed Leeville Mine, and Lone Tree Mine on flow, water quality, and channel stability.

5.2.1 Mine Dewatering and Localized Water Management Activities

Table 1-4 summarizes both the historic and projected future dewatering activities for the Goldstrike Mine, Gold Quarry Mine, and proposed Leeville Mine. The historic activities extend from the initiation of ground water pumping for the mines through the end of 1998. The projected future dewatering and water management activities extend from 1999 through the currently projected end date for ground water pumping and water management activities for each operation.

5.2.1.1 Impacts to Ground Water Levels

Impacts to-Date (1991-1998)

As of the end of 1998, 1,527 feet of drawdown had occurred to-date in the vicinity of the Goldstrike Mine, and 658 feet of drawdown had occurred in the vicinity of the Gold Quarry Mine as a result of mine dewatering. In the vicinity of the proposed Leeville Mine, 360 feet of drawdown had occurred from existing dewatering operations at other mines. As shown in Figure 5-2, mine dewatering has resulted in the development of cones of depression in the ground water surface in the vicinity of the Goldstrike and Gold Quarry mines; both cones of depression exhibit a northwest-southeast elongation. Where the cones of depressions from the two projects overlap, there are cumulative drawdown effects caused by a combination of incremental drawdown from each project. To-date, the cones of depression from the two mines apparently have merged in the region between the two mines located

beneath the Tuscarora Mountains southeast of the Carlin Mine.

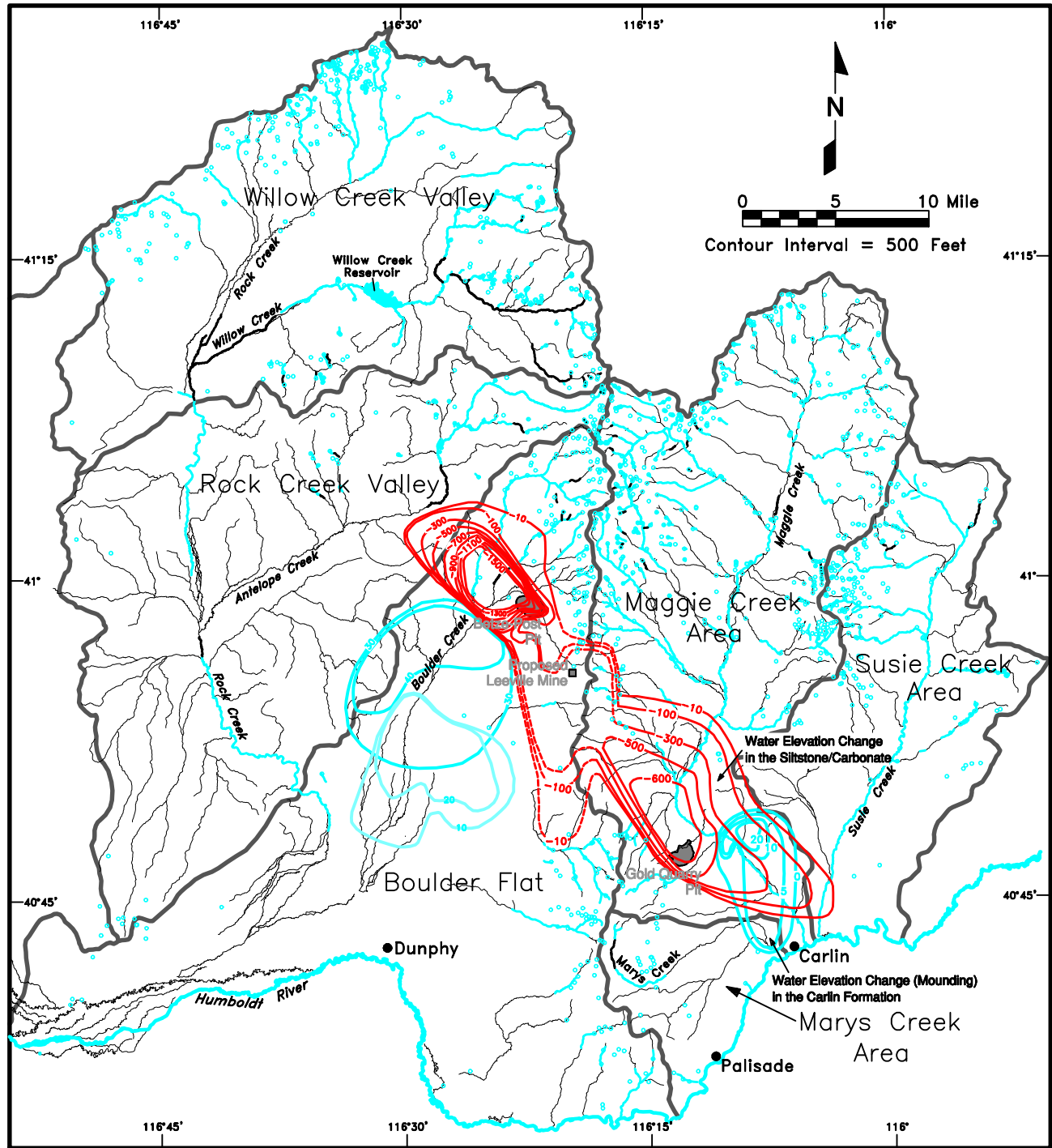
Infiltration of excess mine water from the dewatering operations has resulted in an increase in water levels, or mounding, in the upper Boulder Valley and lower Maggie Creek areas. As of the end of 1998, water levels in the Boulder Valley region had risen approximately 70 feet in the rhyolite in the Sheep Creek Range and 50 feet in the alluvium in upper Boulder Valley. Seepage from Maggie Creek Reservoir and through infiltration along portions of lower Maggie Creek has resulted in an increase in water levels up to 45 feet.

As discussed in Section 3.2.2, several springs located within the current drawdown area resulting from dewatering at the Goldstrike Mine have dried up or shown a reduction in flow (see Table 3.2-22); some of these effects may be related to mine dewatering. The flow and vegetation in Brush Creek, a tributary to Rodeo Creek, have changed substantially since 1993, indicating that this drainage has been impacted by mine dewatering. No other stream impacts have been identified on the western side of the Tuscarora Mountains. In addition, no effects on monitored spring flows have been identified in the vicinity of the Gold Quarry Mine.

Predicted Future Impacts (Post-1998)

Both Barrick and Newmont have developed numerical ground water models that encompass the regional hydrologic study area. Each model was used to simulate the combined or cumulative hydrologic effects resulting from dewatering and water management activities at all three mines (Goldstrike, Gold Quarry, and Leeville). An overview of the model set-up and results of the cumulative simulations for different time periods are provided in Appendix D of the CIA report (BLM 2000b).

Both models predict that the extent and magnitude of the cone of drawdown would vary over time and persist for an extended period postmining (see Appendix D of the CIA report [BLM 2000b]). As a result of conceptual differences in hydrogeologic conditions, including hydraulic parameters, each model produces



Legend

- Ground Water Basin Boundary
- Stream (Intermittent or Ephemeral)
- Perennial Stream
- Discontinuous Flowing Stream Reach
- Spring and Seep
- Water Level Decline in Area of Pumping in Feet
- Water Level Mounding in Area of Irrigation in Feet
- Water Level Mounding in Area of Infiltration/Injection in Feet

Figure 5-2

Current Drawdown and Mounding (End of 1998)

unique results; however, both models are physically reasonable interpretations, and the BLM considers both of them acceptable. Both models predict that the cone of drawdown would continue to expand and reach a maximum (in most directions) at approximately 100 years postmining.

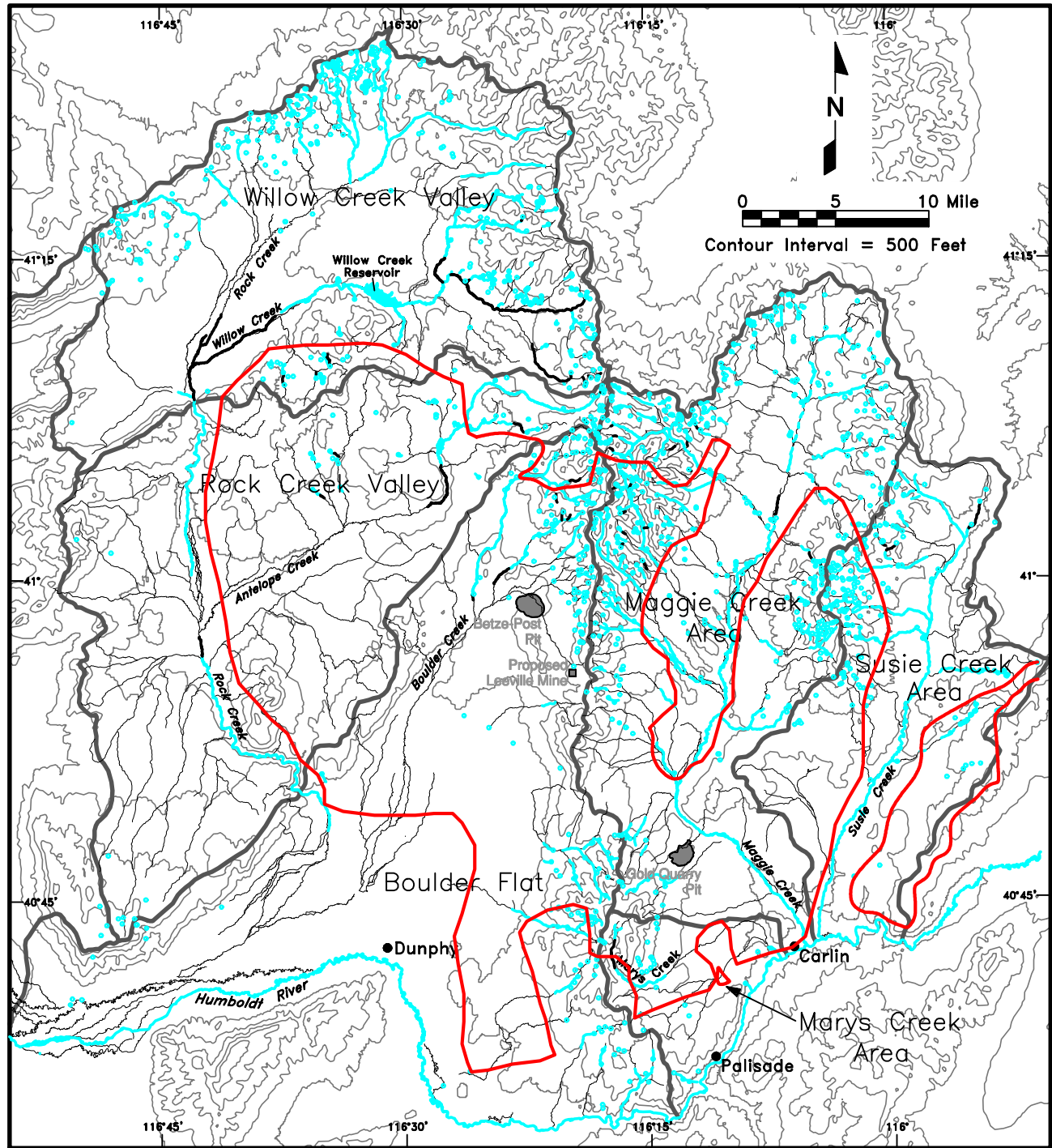
Barrick's and Newmont's calibrated models were used to estimate the change in ground water levels over regular time intervals throughout the future mining and postmining period up to final recovery. The results from both models were then combined to illustrate the predicted maximum extent of 10-foot drawdown irrespective of time, resulting from the three mine operations as presented in Figure 5-3 (Barrick 1998c; Newmont 1999a). It is important to understand that the maximum extent of the 10-foot drawdown contour as shown in Figure 5-3 reflects both (1) areas where the individual cones of drawdown from the three separate projects overlap to cause a larger area and magnitude of drawdown (such as areas located between the mine projects); and (2) areas where the cones of drawdown from the separate projects do not overlap and the predicted drawdown reflects only an individual project (such as the areas located west and north of the Goldstrike Mine).

Figure 5-4 illustrates the difference between the predicted maximum extent of drawdown (10 feet or greater) for the Goldstrike Mine and the predicted maximum extent of drawdown resulting from the combined (or cumulative) dewatering at the Goldstrike, Gold Quarry, and Leeville mines. This comparison indicates that compared to the predicted drawdown area for the Goldstrike Mine, the predicted cumulative drawdown area encompasses substantially larger areas of the Rock Creek Valley, Boulder Flat, Maggie Creek, Marys Creek, and Susie Creek hydrographic areas.

For the area located west and northwest of the Betze-Post Pit, in the Rock Creek Valley area, the predicted cumulative drawdown cone extends up to an additional 12 miles farther than the drawdown predicted for the Goldstrike Mine. This difference in area results from the use of two different models; predictions for the Goldstrike Mine were determined using the Barrick numerical model, whereas the predictions of cumulative drawdown were determined by

combining the cumulative simulation results from both the Barrick and Newmont models to establish the maximum extent of cumulative drawdown (BLM 2000b). As presented in Appendix D of the CIA report (BLM 2000b), the predicted extent of the cumulative drawdown area is different between the Barrick and Newmont models. In the area west and northwest of the Betze-Post Pit, Barrick's model predicts that the drawdown resulting from the Goldstrike Mine and drawdown resulting from the cumulative mine drawdown would be very similar. These modeling results suggest that dewatering from the Leeville and Gold Quarry projects would have negligible impacts to the Rock Creek Valley Hydrographic Area. The Newmont model predicts that the cumulative drawdown in this area would extend up to an additional 12 miles farther than predicted by the Barrick model. When the results of the two models were combined to determine the maximum extent of drawdown for the cumulative analysis, the Newmont model results were used for this area since the Newmont model results indicated a larger areal extent. Therefore, the apparent incremental increase in impacts in this area between the Goldstrike Mine and the cumulative case (as shown in Figure 5-4) results from the difference in predictions between the Barrick and Newmont models. These differences in model predictions reflect the conceptual differences in hydrogeologic conditions, including hydraulic parameters, used for each of the numerical models (see Appendix D of the CIA report [BLM 2000b]). Therefore, the differences in model predictions illustrate the uncertainty regarding the actual areal extent of cumulative drawdown that could occur within this region over the long term.

In the upper Maggie Creek area located northeast of the Betze-Post Pit, an apparent incremental difference occurs between the drawdown predictions for the Goldstrike Mine and the area of predicted cumulative impact. The Barrick model predicts that drawdown (greater or equal to 10 feet) from both the Goldstrike Mine alone and from the cumulative mine drawdown scenario (Appendix D of the CIA report [BLM 2000b]) would not extend into this region. Therefore, based on the Barrick model results, drawdown resulting from the Goldstrike Mine is not anticipated to contribute to cumulative impacts to the upper Maggie Creek area. In contrast, the Newmont model predicts that the

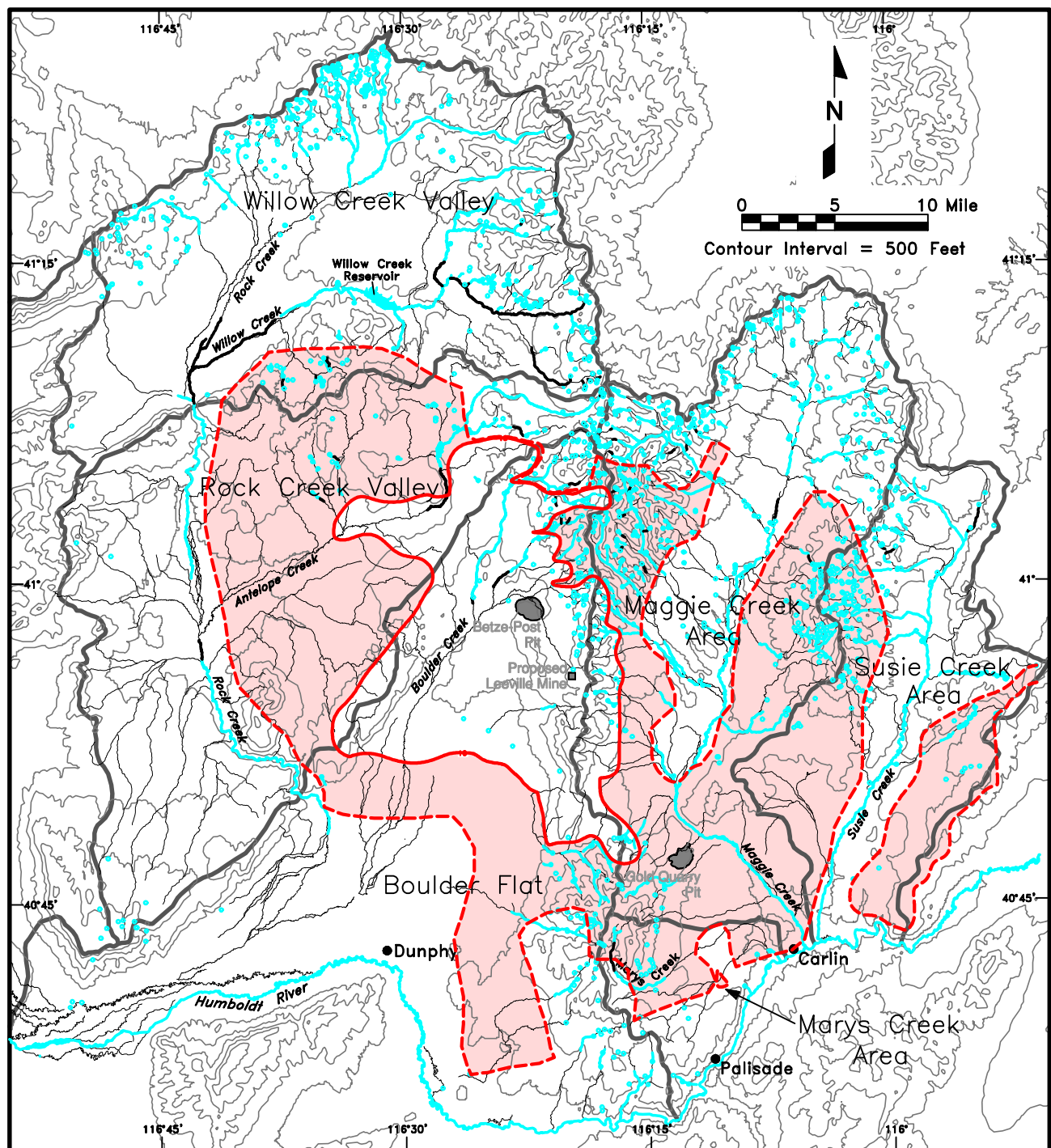


Legend

- Ground Water Basin Boundary
- Maximum Extent of the Cumulative 10-foot Drawdown Contour
- Stream (Intermittent or Ephemeral)
- Perennial Stream
- Discontinuous Flowing Stream Reach
- Spring and Seeps

Figure 5-3

Predicted Maximum Extent
of the Cumulative 10-Foot
Drawdown Contour



¹ See text in Section 3.2.2.1 for explanation
² See BLM 2000b for explanation

Figure 5-4

Comparison of the Predicted Goldstrike Mine Drawdown Area and the Cumulative Drawdown Area

cumulative drawdown would extend up to an additional 10 miles to the northeast than the Barrick model into the upper Maggie Creek area. Therefore, the predicted cumulative drawdown for this area, based on the maximum drawdown predicted by the combined Barrick and Newmont models, also reflects the fact that the Newmont model predicts a substantially larger areal extent of drawdown than the Barrick model (Appendix D of the CIA report [BLM 2000b]). These contrasting results from the two models again indicate the uncertainty of the actual areal extent of cumulative drawdown that could potentially occur in the upper Maggie Creek area in the post-dewatering period.

In the area between the Goldstrike Mine and Gold Quarry Mine, the increase in drawdown area predicted for the Goldstrike Mine compared with the cumulative scenario reflects the overlapping cones of depression (or incremental contribution) from the Goldstrike, Gold Quarry, and Leeville mines. The Leeville Project, and to a lesser extent the Gold Quarry Project, would likely contribute to the cumulative drawdown in portions of the Boulder Flat Hydrographic Area. Drawdown from the Goldstrike Mine is predicted to have a relatively small incremental contribution to drawdown along the southwestern portion of the Maggie Creek Hydrographic Area. However, the increased drawdown area in the lower Maggie Creek, Marys Creek, and Susie Creek areas reflects the drawdown cones from the Gold Quarry and Leeville mines.

5.2.1.2 Impacts to Perennial Springs and Streams

As listed in Table 5-1, there are 537 springs and seeps located within the predicted combined cumulative 10-foot drawdown area. Hydrogeologic conditions, spring and seep surveys, elevations, and geochemistry for representative springs were considered to identify areas within the maximum predicted 10-foot contour that could potentially be impacted by mine dewatering (BLM 2000b). Based on the cumulative analysis, 182 springs and seeps are located in areas where perennial surface waters could potentially be impacted by drawdown (Figure 5-5). These potential impacts are discussed in detail by area in the CIA report (BLM 2000b).

Flows in some stream reaches could be reduced as a result of the mine-induced drawdown from the Goldstrike, Leeville, and Gold Quarry mine operations. Drawdown could impact flows in lower Maggie Creek, lower Marys Creek and adjacent areas, lower Susie Creek, Rock Creek, and Boulder Creek; the actual magnitude and extent of impacts to perennial streams is uncertain (see BLM 2000b for additional details).

5.2.1.3 Impacts to Ground Water Rights

Ground water modeling results indicate that water levels at 115 ground water right point of diversion locations (with current *permit*, *certificate*, or *vested* status) could be lowered by at least 10 feet during the mine life or in the postmining period as a result of Barrick and/or Newmont ground water pumping (Table 5-2). The point of diversion locations listed for 34 applications for ground water rights also are located within the cumulative 10-foot drawdown contour. In addition, there are five known wells (without water rights status) located within the identified cumulative drawdown area. Lowering the water levels in these wells would potentially reduce yield, increase pumping cost, or if the water level were lowered below the pump setting or below the bottom of the wells, the well would become unusable.

5.2.1.4 Impacts to Surface Water Rights

A potential reduction in the baseflow of perennial springs and streams could affect surface water rights within the drawdown area. As listed in Table 5-3, there are 45 surface water rights located within the potential cumulative drawdown area. Thirty-two of these water rights are used either for irrigation or stock watering, and 13 are used for domestic, mining and milling, municipal, or other uses. The actual potential for impacts to individual water rights would depend on the site-specific hydrologic conditions that control surface water discharge.

5.2.1.5 Impacts to the Regional Ground Water Balance

As presented in Tables 1-4 and 1-5, the combined pumping from the Goldstrike, Gold Quarry, and Leeville mines would result in an estimated total pumped volume of approximately

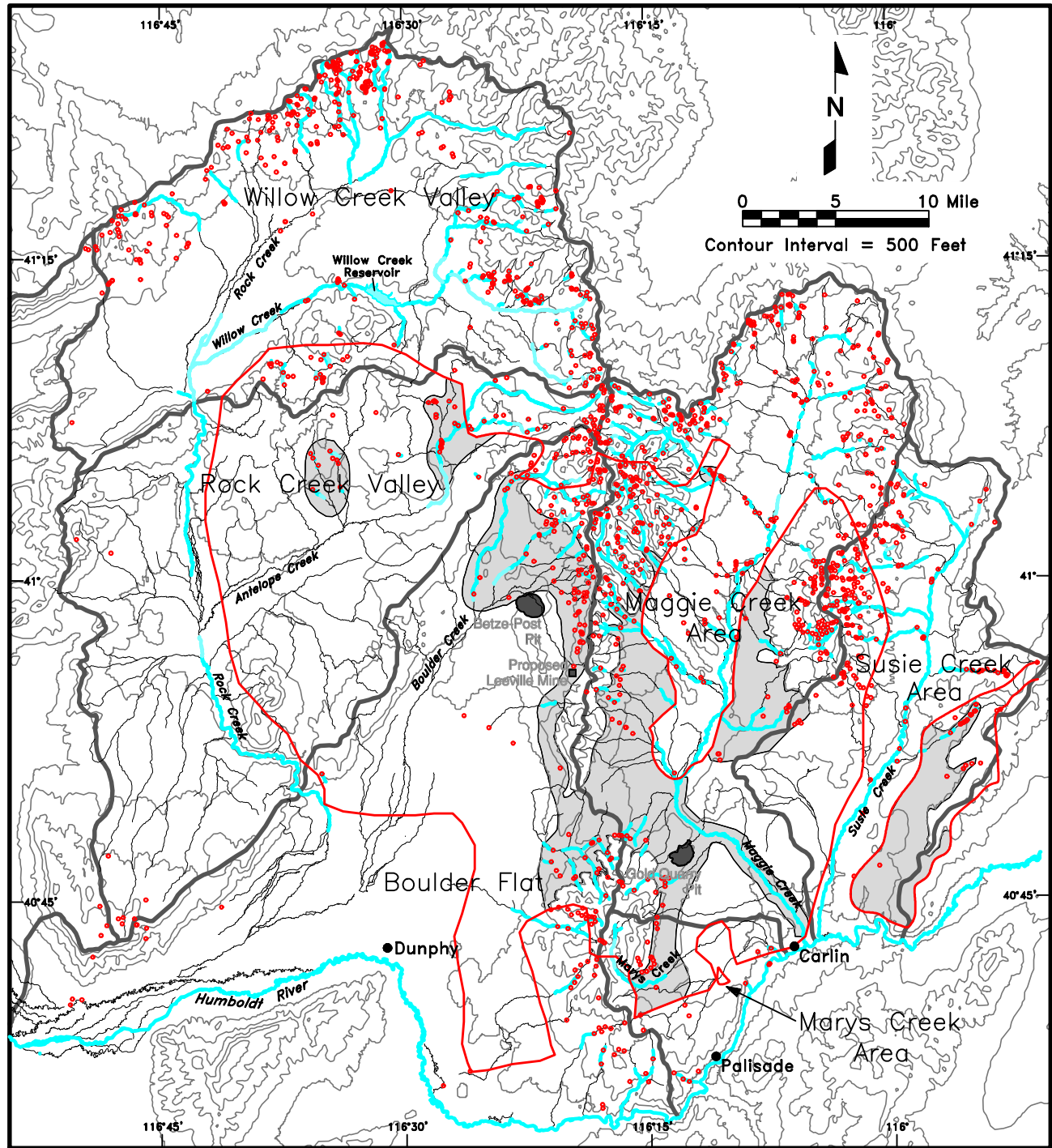
Table 5-1
Summary of Springs Within the Predicted Cumulative Drawdown Area

Ground Water Basin	Total Number of Known Springs and Seeps Within Cumulative Drawdown Area	Number of Known Springs and Seeps (within cumulative drawdown area) Located in Areas Where Surface Waters Potentially Could Be Impacted By Drawdown ¹
Willow Creek Valley	22	0
Rock Creek Valley	31	27
Boulder Flat	122	74
Maggie Creek	217	48
Marys Creek	19	11
Susie Creek	126	22
Total	537	182

¹See Figure 5-5.

Table 5-2
Summary of Ground Water Rights Within the Cumulative Drawdown Area

Ground Water Basin	Domestic	Irrigation	Mining/ Milling	Municipal	Stock	Other	Total
Ground Water Right with Current <i>Permit, Certificate, or Vested Status</i>							
Susie Creek Area	0	0	0	0	6	0	6
Maggie Creek Area	0	6	0	1	9	0	16
Marys Creek Area	0	3	0	3	1	3	10
Boulder Flat	0	39	10	0	21	2	72
Rock Creek Valley	0	0	10	0	1	0	11
Willow Creek Valley	0	0	0	0	0	0	0
Total	0	48	20	4	38	5	115
Applications for Ground Water Right and Other Known Wells							
Susie Creek Area	0	6	0	0	0	0	6
Maggie Creek Area	3	0	0	0	2	9	14
Marys Creek Area	0	0	0	0	0	0	0
Boulder Flat	0	12	0	0	2	0	14
Rock Creek Valley	0	0	0	0	0	0	0
Willow Creek Valley	0	0	0	0	0	0	0
Total	3	18	0	0	4	9	34



Legend

- Ground Water Basin Boundary
- Cumulative Drawdown Area (≥10 Feet of Drawdown)
- Perennial Streams
- Discontinuous Flowing Stream Reach
- Spring and Seep
- Areas where Perennial Waters could Potentially be Impacted by Drawdown¹
- Areas where Perennial Waters have a Low Probability of Being Impacted by Drawdown¹

Note: ¹ Does not include potential impacts to perennial waters located outside the cumulative 10-foot drawdown contour.

Figure 5-5

Potentially Impacted Perennial Waters Within the Cumulative Drawdown Area

Table 5-3
Summary of Surface Water Rights Within the Cumulative Drawdown Area

Ground Water Basin	Domestic	Irrigation	Mining/ Milling	Municipal	Stock	Other	Total
Surface Water Right with Current <i>Permit, Certificate, or Vested</i> Status							
Susie Creek Area	0	0	0	0	0	1	1
Maggie Creek Area	0	3	0	0	4	0	7
Marys Creek Area	0	0	0	4	0	4	8
Boulder Flat	1	7	0	0	7	3	18¹
Rock Creek Valley	0	0	0	0	9	0	9
Willow Creek Valley	0	0	0	0	2	0	2
Total	1	10	0	4	22	8	45¹

¹Twelve of these surface water rights are primary and secondary storage at the TS Ranch Reservoir associated with mine dewatering rights.

2,000,000 acre-feet of water. An estimated 800,000 acre-feet (or 40 percent) of the pumped volume would be returned to the ground water system by infiltration activities (e.g., irrigation activities, injection, reservoir seepage); an estimated 570,000 acre-feet (29 percent) would be discharged to the Humboldt River and thereby removed from the hydrologic study area. (Note that the infiltration estimates assume 30 percent of the total volume of water used for crop irrigation infiltrates to ground water.) The remaining 630,000 acre feet (31 percent) of the pumped ground water includes water (1) used for crop irrigation, (2) used at the mine sites for mining and milling and other operations, or (3) lost by evaporation. The collective mine dewatering operations, water management activities, and ground water inflow to pit lakes during the postclosure period would change the general water balance in the hydrologic study area.

Model simulated changes in the ground water budgets for the hydrologic study area resulting from the combined effects of the Goldstrike, Leeville and Gold Quarry Mines are presented in the CIA report (BLM 2000b). The results of the model predict that there would be no changes in the Willow Creek Hydrographic Area and only minor changes in the Marys Creek and Susie Creek Hydrographic Areas (Barrick 1998c). The model simulations also predict that the combined mine-induced drawdown and water management activities would result in a noticeable change in the water balance, particularly in the Boulder Flat and Maggie Creek Hydrographic Areas, and to a

lesser extent in the Rock Creek Hydrographic Area.

For the Boulder Flat Hydrographic Area, the simulated ground water balance suggests that during mining the amount of subsurface flow from adjacent basins into the Boulder Flat Hydrographic Area has nearly doubled and would continue to be substantially higher than premine conditions throughout the mine life but would return to near premine conditions in the postmining period. The simulated water balances also suggest that there already has been a substantial increase in infiltration from streams, and infiltration resulting from reservoir seepage, pond infiltration, irrigation, and injection wells. However, all of these increases in infiltration are predicted to be short-term. In later stages of the Goldstrike Mine life, as represented by the water balance for 2011, infiltration is predicted to be similar to premine conditions with the exception of additional infiltration from irrigation activities. Ground water outflow would increase substantially during mining as a result of the combined effects of pumping and increased evapotranspiration resulting from ground water mounding and crop irrigation in Boulder Valley. In the postmining period, the amount of evapotranspiration is simulated to be less than premine conditions. This predicted long-term postmining reduction in evapotranspiration reflects the fact that as the water table is lowered, there would be less ground water loss through evapotranspiration processes. In the postmining period, some ground water outflow from the system would occur as seepage for pit lake filling,

and at steady state, to replace water lost from pit lake evaporation. During mining, ground water outflow is greater than inflow, resulting in reduction in ground water stored in aquifers in the hydrographic area. However, in the postmining periods, there is predicted to be approximately 4 percent more inflow than outflow, resulting in a gradual increase (and partial recovery) of ground water stored in the basin.

The simulated water balances for the Maggie Creek Hydrographic Area indicate that mine dewatering is anticipated to increase ground water outflow from the Maggie Creek Hydrographic Area during mining, mainly to the Boulder Flat Hydrographic Area. During mining, pumping results in a reduction in ground water in storage. However, reductions in storage are not anticipated within the 50-to 100-year postmining period.

The Rock Creek Hydrographic Area simulated water balances indicate both subsurface inflow and outflow would increase up to approximately 70 percent compared to estimated premine conditions. Increased subsurface inflows are largely the result of mounding expanding into this area from mine infiltration activities in the adjacent Boulder Flat Hydrographic Area. Increased subsurface outflow indicates that drawdown from the adjacent Boulder Flat Hydrographic Area results in additional movement of ground water into the Boulder Flat Hydrographic Area. Drawdown is anticipated to result in a reduction of ground water stored in this hydrographic area during mining and into the postmining period.

5.2.2 Humboldt River

Figure 5-6 shows the current estimated discharges (historical and projected) for each mine, as well as the estimated cumulative mine discharge for the period 1992 through 2011. The future discharges (shown in Figure 5-6) are based on the most recent projections from individual mining operations (BLM 2000b). Surface discharge of excess mine dewatering water was initiated in 1992 and increased between 1992 and 1998. Discharges to the Humboldt River have increased over time since the early 1990s to a maximum of approximately 100,000 gpm.

On an individual basis, the Lone Tree Mine began discharging excess mine dewatering water to the Humboldt River in 1992; the Gold Quarry Mine began discharging to Maggie Creek near Carlin, Nevada, in 1994; and the Goldstrike Mine discharged water to the Humboldt River from September 1997 to February 1999. In addition, the proposed Leeville Mine is anticipated to discharge to the river through the existing Goldstrike Mine water conveyance system beginning in the year 2000. All of these individual mine discharges would combine to produce the highest cumulative discharges to the river during the years 1999 through 2006. Substantially smaller cumulative discharges are planned to continue from 2007 through 2011. The mines would not necessarily discharge to the river during the entire time they would be dewatering or conducting operations. In addition, rates of discharge to the river may increase or decrease in the future as the mines continue their water management programs.

Comparison of monthly flows recorded at USGS gaging stations on the Humboldt River (1946 to 1990) with flows during the mine discharge period (1992 to 1998) indicate that for all months except January 1997 at Battle Mountain, the range of flows recorded during the discharge period (1991 to 1998) are within the range of flows recorded historically (1946 to 1990). Flows in January 1997 at Battle Mountain were greater than recorded during the premine discharge period; however, mine discharge for this period represented only 3 percent of the flow.

In order to assess future potential impacts of mine discharges to the Humboldt River, dewatering discharge scenarios were simulated by computer modeling (RTi 1998). Changes to river flows were estimated by superimposing the monthly mine flows from the maximum predicted cumulative year of dewatering discharge onto the river flows and running the computer model. These simulations were conducted for a historic low-flow year, a historic average year, and a historic high-flow year, based on streamflow records and data for the period 1946 through 1990. The simulations accounted for seasonal irrigation diversions and returns assuming that future irrigation diversion rates remained similar to those of the present day. The results presented in Figures 5-7 and 5-8 illustrate the combined

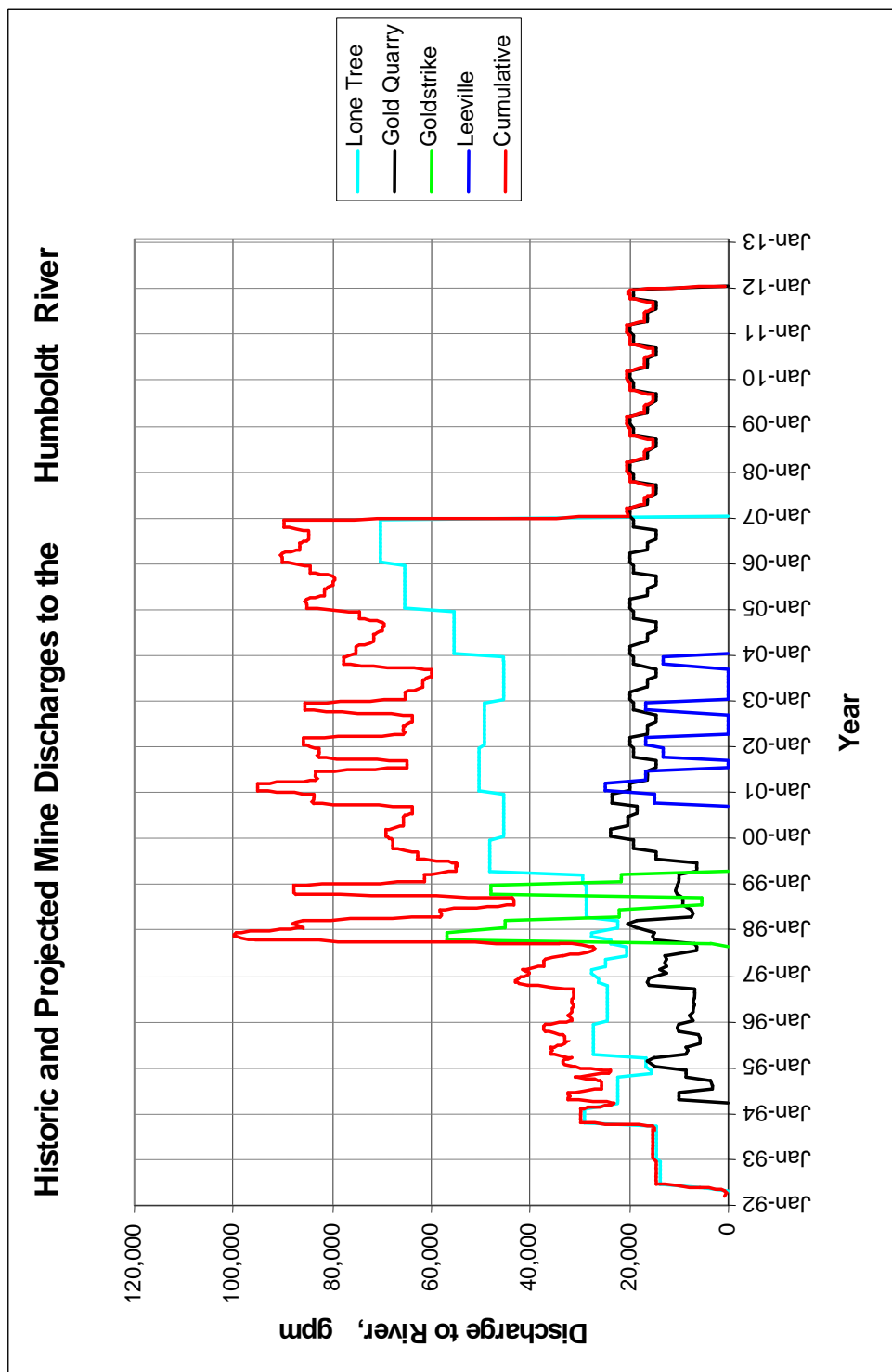


Figure 5-6
Cumulative Mining Discharges
to the Humboldt River

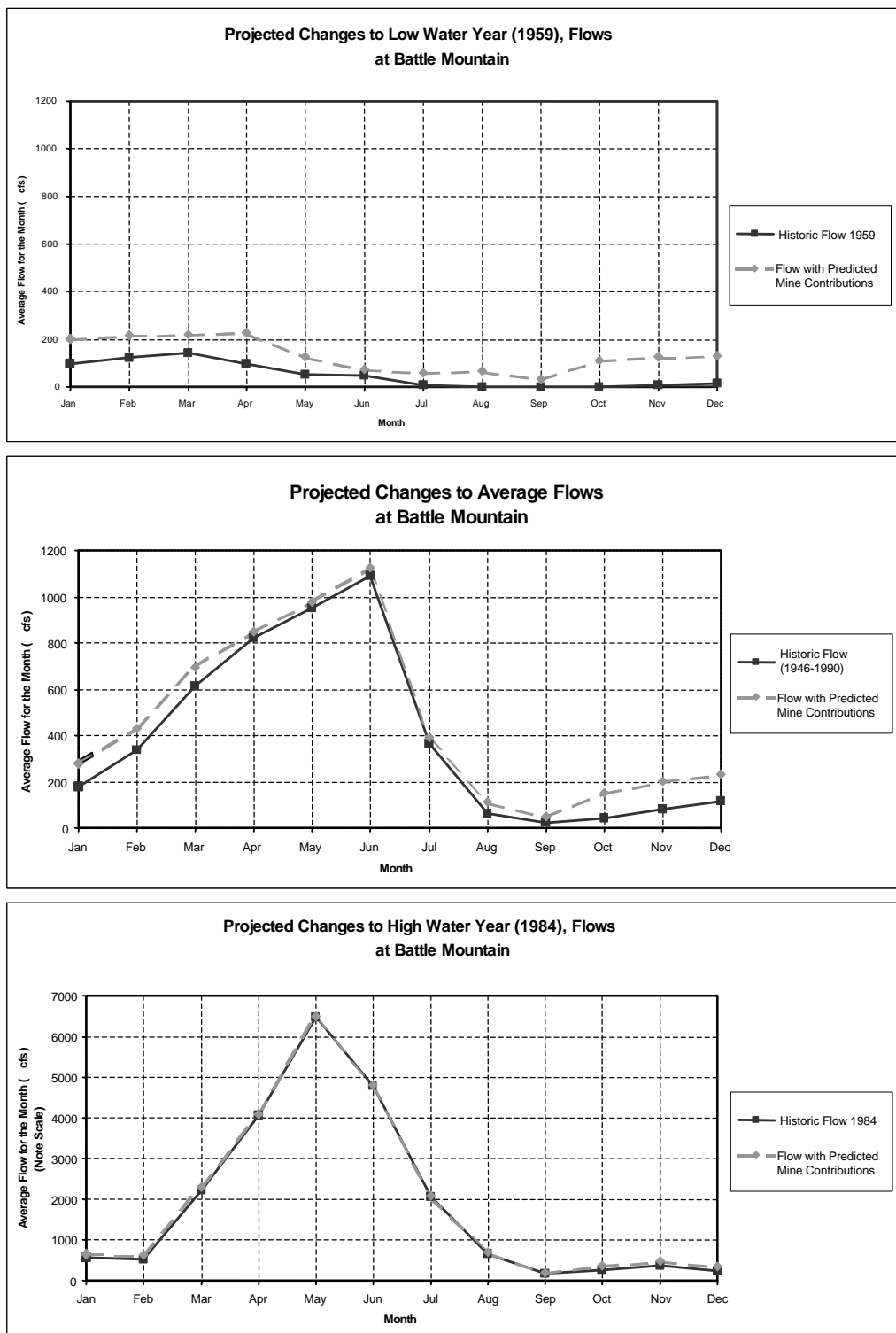


Figure 5-7
Projected Changes to
Flows at Battle Mountain

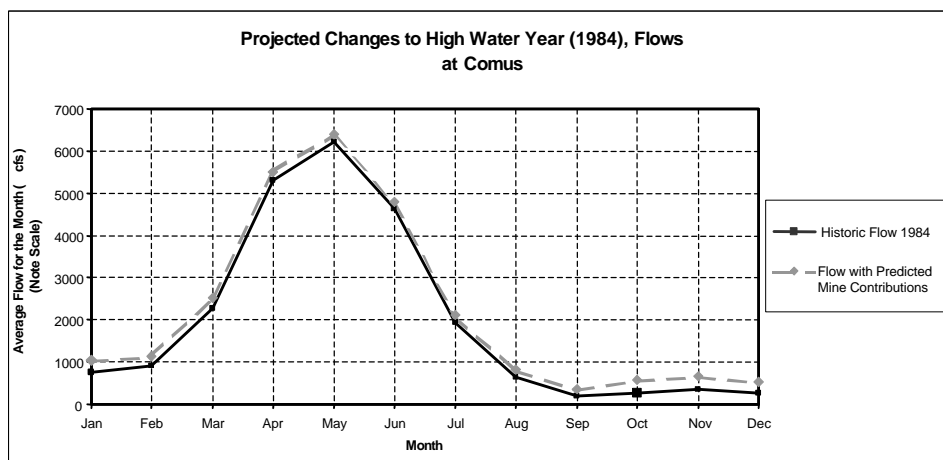
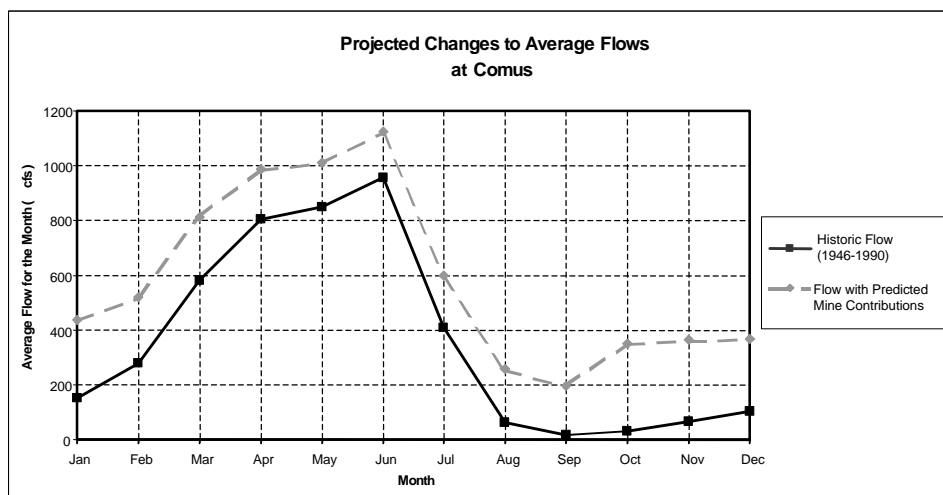
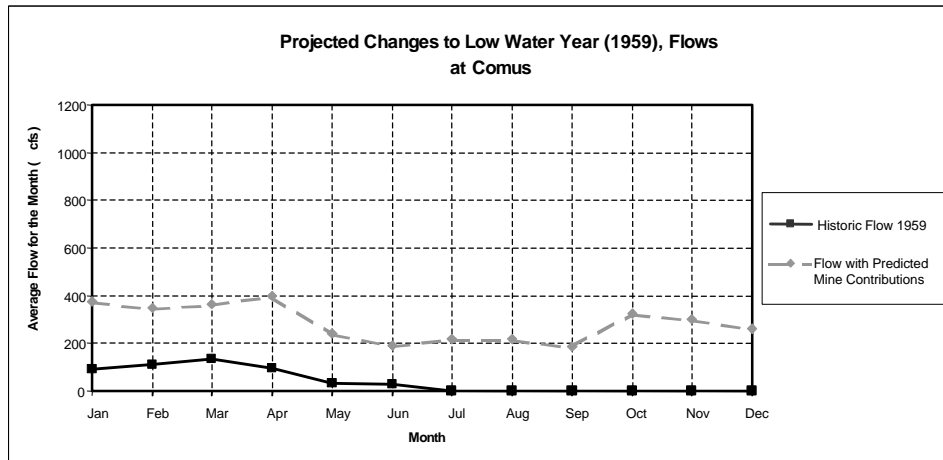


Figure 5-8
Projected Changes to
Flows at Comus

flows in the river that are predicted at Battle Mountain and Comus when the maximum cumulative mine discharges are simulated along with an historical low flow year, average river flow, and high flow year (RTi 1998).

Modeling of projected future discharges indicates that compared to the average premine conditions, the largest percentage increase in flow would occur in the lower flow months, and relatively little changes in flow are anticipated during the peak flow months. Simulation of changes to flow during the a low-flow year indicate that there is a large relative change to the average monthly flows for the low-flow (fall) months at both the Battle Mountain and Comus gages under the maximum discharge scenario. Simulated hydrographs showing the projected effects of maximum cumulative discharges are shown in Figures 5-7 and 5-8.

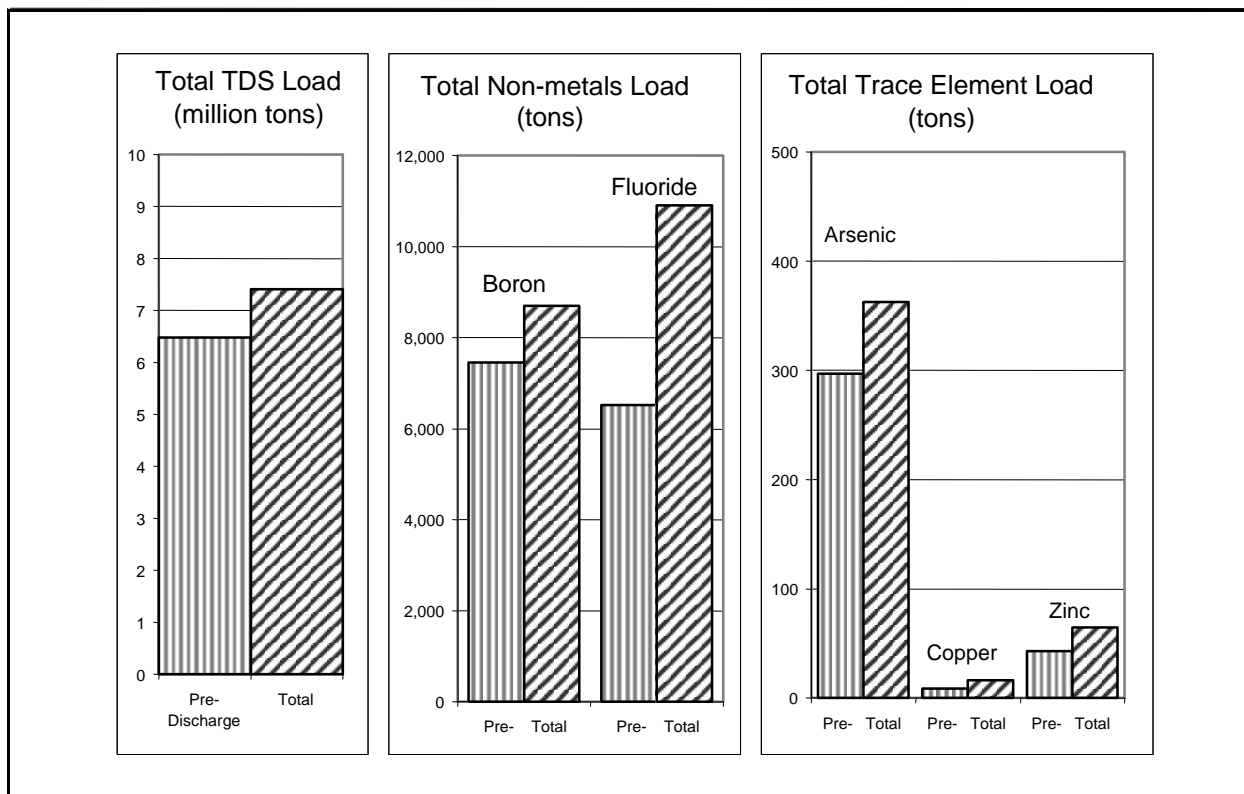
The increased Humboldt River flows are not anticipated to create additional flooding along the river upstream of Rye Patch Reservoir. The cumulative mine discharges would contribute to the stored volume in Rye Patch Reservoir and may present difficulties during high-flow years in preserving emergency storage and minimizing flooding and structural damages downstream. Effects related to stream erosion, sedimentation, and channel geometry from the cumulative discharges are likely to be small upstream of Battle Mountain and would probably be overshadowed subsequently by natural spring runoff. In the Comus area, impacts from bed and bank erosion may occur. Irrigation diversion structures immediately upstream of the Comus gage and in the Dunphy-Argenta area may require additional maintenance or improvements as a result of increased flows or river geometry changes. Substantial long-term impacts on surface water rights within the Humboldt River basin are not anticipated.

Drawdown from the cumulative mine dewatering operations could reduce baseflow in the Humboldt River (BLM 2000b). The cone of depression resulting from Goldstrike Mine dewatering is not predicted to extend to (or result in decreased flows to) the Humboldt River; therefore, mine-induced drawdown from the Goldstrike Mine is not predicted to contribute to potential reductions in baseflow in the river.

Cumulative mine drawdown from the other mine projects included in the analysis is predicted to result in flow reductions that would gradually increase to a temporary maximum of approximately 2 to 3 percent of the average annual volume by the years 2016 to 2019 (BLM 2000b). Table 5-4 shows the predicted maximum decreases during the low-flow season relative to the historic monthly average flows as determined by HCI (HCI 1997a). These reductions in flow would represent a larger percentage of the flow during the low-flow months. Flows are predicted to gradually return to the historic average annual volumes in the postmining period. Newmont has committed to mitigate these potential impacts to flows by augmenting low flows in the river (if necessary) using senior water rights that the company owns or controls (BLM 1993d).

Mine discharges to the Humboldt River have generally been within their permit limitations. One "significant non-compliance violation" was documented under the current NPDES permits; discharges from the Lone Tree Mine were in non-compliance for arsenic in early 1995, but treatment and dewatering systems were adjusted to correct the NPDES permit exceedence. Provided that all of the mine discharges remain within their permit limitations, cumulative impacts to water quality in the river are not anticipated.

On an average annual basis, the mine discharges represent a loading increase in TDS, arsenic, boron, copper, fluoride, and zinc compared with Humboldt River premine conditions. The historic and projected future loads contributed from discharge from the Goldstrike Mine are discussed in Section 3.2.2.3 and shown in Figure 3.2-44. As shown in Figure 5-9, cumulative loads from the mine discharges would likely increase TDS, arsenic, boron, and fluoride loads to the Humboldt Sink over the mine discharge period. Comparisons between Figure 3.2-44 and Figure 5-9 indicate that the historic and projected future discharges from the Goldstrike Mine represent a relatively small incremental increase of the total loads from the cumulative mine discharge. Depending on concentrations in the Humboldt Sink, parameter solubilities, and other physical and biological factors, these increased loads to the sink from the cumulative mine discharge potentially could result in increased concentrations in the sink wetlands.



Comparison of the dissolved loads without any mine discharge contribution (vertical fill) with potential total dissolved loads during the discharge period (slashed fill) over the entire historic and projected future discharge period (1992-2018) to the Humboldt Sink.¹ Note that 1) estimates of loads to the sink are based on limited premine data; and 2) actual mine contributed loads reaching the sink could be less than total potential (see BLM 2000b for additional explanation).

¹ Assumes that the average annual pre-discharge loads, or baseline loads, carried by the river remain constant over the mine discharge period.

Figure 5-9

Potential Cumulative Increase
in Loads During the Mine
Discharge Period at the
Humboldt Sink

Table 5-4
Projected Maximum Decreases in Humboldt River Flow
Resulting from Cumulative Drawdown
(cfs, rounded)

Streamgage Location	July	August	September	October	November
Argenta					
Average Historical Flow	332	38	13	22	58
Maximum Predicted Decrease	-8	-8	-8	-8	-8
Battle Mountain					
Average Historical Flow	325	43	14	26	64
Maximum Predicted Decrease	-8	-8	-8	-8	-8
Comus					
Average Historical Flow	404	70	18	27	56
Maximum Predicted Decrease	-8	-8	-8	-8	-8

Source: HCI 1997a.

5.2.3 Proposed Action and No Action Alternative

No cumulative impacts to water resources are anticipated from the Proposed Action or the No Action Alternative.

5.3 Riparian Vegetation

Perennial creeks within the cumulative assessment area typically support a riparian zone ranging in width from a few feet immediately adjacent to the creek channel to relatively wide zones on broad floodplains. Riparian areas are valuable in providing sediment retention, nutrient removal and transformation, increased production (relative to uplands) for livestock and wildlife forage, habitat diversity for aquatic and terrestrial wildlife, and streambank stability.

Approximately 4,355 acres of riparian/wetland habitat occur within the cumulative assessment area, of which 2,025, 1,705, 228, 388, and 10 acres are associated with the Maggie Creek, Rock Creek, Susie Creek, Humboldt River watersheds, and small tributaries to the Humboldt River, respectively. Eight riparian vegetation types are present including streambar, herbaceous streambar, wet meadow, Salix streambar, Salix/wet meadow, Salix/mesic meadow, Salexi/mesic meadow, and ALNINC/mesic meadow.

5.3.1 Mine Dewatering and Localized Water Management Activities

The potential for impacts to riparian areas is based on the (1) predicted ground water drawdown and (2) the connectivity of the perennial streams, seeps, and springs supporting riparian vegetation with the regional ground water aquifer (see Section 5.2.1.2, Impacts to Perennial Springs and Streams).

Ground water model simulations suggest that reductions in baseflow could occur in lower Rock Creek, Boulder Creek, Marys Creek, upper and lower Maggie Creek, and lower Susie Creek. However, because of the limitations inherent in hydrologic modeling and the uncertainty regarding the hydrologic interconnection between the streams and the regional ground water system, the actual extent and magnitude of impacts to riparian vegetation are uncertain.

Approximately 600 acres (14 percent) of the 4,337 acres of riparian vegetation within the cumulative assessment area (Table 3.3-1) occur within the areas where perennial waters could be impacted by ground water drawdown. The following sections provide specific information regarding riparian vegetation that potentially could be affected by ground water drawdown by individual watershed.

5.3.1.1 Maggie Creek Watershed

The Maggie Creek watershed includes approximately 47 percent of the riparian vegetation within the cumulative assessment area. The watershed supports approximately 2,025 acres of riparian vegetation, of which approximately 366 acres (18 percent) occur within areas where some impacts could occur. The majority of the riparian vegetation that occurs in areas that could be impacted by ground water drawdown is associated with Maggie Creek (246 acres), Lynn/Simon Creek (19 acres), Beaver Creek (35 acres), Coyote/Spring Creeks (15 acres), and Little Jack/Jack Creeks (20 acres). Other smaller parcels of riparian vegetation in these potentially affected areas include James Creek (5 acres), Marys Creek (10 acres), Cottonwood Creek (5 acres), Fish Creek (3 acres), East Cottonwood Creek (6 acres), and Indian Creek (1 acre).

Some of the riparian habitats associated with the Maggie Creek Watershed Restoration Project (MCWRP) are located within the area that potentially could be affected by ground water drawdown. However, impacts to these areas are not anticipated since water augmentation projects have been proposed, which are intended to compensate for the potential loss or reduction of ground water in the area.

5.3.1.2 Rock Creek Watershed

The Rock Creek watershed includes approximately 39 percent of the riparian vegetation within the cumulative assessment area. This watershed includes approximately 1,685 acres of riparian vegetation, of which approximately 228 acres (14 percent) occur within areas that could be impacted by drawdown. Riparian vegetation that could be affected by ground water drawdown is associated with Boulder Creek (148 acres), Antelope Creek (70 acres), and Welches Creek (10 acres).

5.3.1.3 Susie Creek Watershed

The Susie Creek watershed includes approximately 228 acres of riparian vegetation, of which approximately 1 acre (less than 1 percent) is within areas that potentially could be affected by ground water drawdown. Riparian vegetation

that could be affected by ground water drawdown is associated with Middle Susie Creek.

5.3.1.4 Small Tributaries to the Humboldt River

These tributaries support approximately 10 acres of riparian vegetation, of which approximately 4 acres (40 percent) are within areas that potentially could be affected by ground water drawdown. Riparian vegetation that could be affected by ground water drawdown is associated with Dry Susie Creek.

5.3.1.5 Humboldt River

The Humboldt River includes approximately 388 acres of riparian vegetation with a low probability of being affected by ground water drawdown.

Exposed channel sediments during reduced baseflow periods would be prone to invasion by noxious weeds. Noxious weed species, including Scotch thistle, Canada thistle, leafy spurge, whitetop, water hemlock, diffuse knapweed, and Russian knapweed that have been observed in the SOAPA study area, could become established within these channels (BLM 2000b). Riparian vegetation would likely dominate these areas after water levels returned to premine conditions.

5.3.1.6 Isolated Springs and Seeps

Approximately 60 isolated springs and seeps, that are not associated with perennial stream reaches, occur within areas where perennial waters could be impacted by drawdown (see Figure 5-5). Based on the SOAPA Draft EIS (BLM 2000a) and the 1993 SOAP EIS (BLM 1993b), the majority of wetlands observed within the Maggie Creek basin range from 0.1 acre to 1.0 acre in size. Assuming that each spring supports an average of 0.3 acre of wetland vegetation, an estimated 18 acres of wetland vegetation occur within areas where perennial waters could be impacted. Therefore, the amount of wetland vegetation in these areas could be reduced.

In summary, according to ground water modeling and associated water resources analyses, approximately 600 acres of riparian vegetation associated with perennial stream reaches and 18

acres of wetland vegetation associated with isolated seeps and springs are located within areas where some reduction in flow could occur. Therefore, riparian and wetland vegetation within these areas could be reduced.

5.3.2 Humboldt River

Natural fluctuations in water levels caused by seasonal variations and flood and drought events greatly influence the distribution and extent of riparian vegetation established within the Humboldt River floodplain. As described previously, additional mine discharges would increase temporarily and mine-induced drawdown would then decrease flows in the Humboldt River. These anticipated water level changes potentially could affect channel configuration, depth, and sinuosity that directly affect the distribution and extent of riparian vegetation.

In general, the peak flow months (i.e., May and June) would not be affected by the additional discharge. Relative to the natural fluctuations in river flows during these months, the increases would be small and would have no impact to the flow regime of the Humboldt River during average peak flow months. Water discharges into the river could result in a substantial increase during low-flow periods. During low-flow periods (September to November), the average water depth could increase approximately 1.5 feet (0.7 to 2.2 feet), and channel width could increase approximately 35 feet (45 to 80 feet) under the maximum combined discharge scenario.

Effects from increased water levels during baseflow periods include an increase in elevated water table in low-lying areas located adjacent to the river, increasing the frequency of flooding of stream meanders and oxbows. Riparian/wetland plants could become established in areas where the water table is elevated to the rooting depths needed for riparian/wetland plant establishment. Stream meanders and oxbows could be more frequently subjected to flood events, further enhancing the potential for riparian/wetland plant establishment. Increased baseflows and slightly increased peak flows could facilitate the establishment of willows along the main river channel and side channels since the water levels would be more constant throughout the year.

Increases in the extent of riparian vegetation would be most noticeable along segments of the river with gradual banks and low-lying areas located adjacent to the river. These areas could be more frequently flooded during peak flows, and the water table could be shallow due to increased baseflows.

An additional effect resulting from increased water levels during low-flow periods would be the potential for restoring or enhancing specific wetland and marsh habitats in Herrin Slough. Riparian/wetland areas currently present in Herrin Slough, which consists of a series of low-gradient channels, could be enhanced by increased baseflows and slightly elevated peak flows. Water levels in Upper and Lower Pitt-Taylor Reservoirs could become more consistent, which would improve conditions for wetland and aquatic plant establishment.

Additional effects may include channel instability in the reach extending approximately 3 miles upstream and downstream from the Barrick outfall, deepening of the river channel, and loss of streamside riparian vegetation due to increased erosion and destabilization of stream banks.

Although cumulative water drawdown may eventually reduce the Humboldt River baseflow after the mines' dewatering discharges cease, the mine-induced drawdown from the Goldstrike Mine is not predicted to contribute to the potential reduction in the river's baseflow.

Small, isolated stands of wetland vegetation that occur along the banks of Rye Patch Reservoir would likely be lost if water levels were consistently high within the reservoir during periods of high water discharge. As a result of consistently high water levels, wetland vegetation could be lost to inundation. Steep banks immediately adjacent to the reservoir would make it difficult for wetland vegetation to become re-established. Wetland vegetation would not become established until water levels were comparable to pre-discharge water levels.

Depending on irrigation withdrawals and returns during the period of discharges, the areal extent of wetland vegetation within the Humboldt Sink could increase as a result of higher and more consistent water levels. Consistent high water

levels in the Humboldt Sink could flood and kill stands of salt cedar. Portions of the sink that were seasonally flooded would likely be perennially inundated, resulting in the temporary loss of emergent wetland vegetation until it becomes established along the margins of the sink. Dense stands of salt cedar could become re-established on exposed sediments during low-water periods. Increased water levels also would increase the extent of open water habitats that would facilitate aquatic plant establishment. These effects would subside when mine discharges cease. Excess water from the Humboldt Sink may occasionally reach the Carson Sink during high-water periods. The Carson Sink is a shallow, highly alkaline playa lake that primarily supports salt-tolerant upland species. However, the occasional influx of water conveyed to the Carson Sink would not result in the establishment of wetland plants.

5.3.3 Proposed Action and No Action Alternative

No cumulative impacts to riparian vegetation or wetlands would result from the Proposed Action or the No Action Alternative.

5.4 Terrestrial Wildlife

5.4.1 Mine Dewatering and Localized Water Management Activities

The ground water drawdown from the mines' dewatering activities could result in a long-term reduction in the amount and extent of available surface water and associated riparian, wetland, and mesic habitats within portions of the cumulative assessment area for a number of terrestrial wildlife species. Approximately 618 acres of riparian/wetland habitats are located in areas associated with isolated springs and seeps and perennial streams that could be affected by the cumulative ground water drawdown (Section 5.3). No estimates for possible effects to mesic habitats were developed. Sections 5.2 and 5.3 discuss these isolated areas that could be affected by ground water drawdown.

Reduction in surface or subsurface flows could result in effects ranging from reduced plant vigor

to the total loss of riparian vegetation cover, depending on a number of hydrological and geological factors. Potential reduction or loss of available water or possible long-term effects to the riparian community could result in a loss of breeding, foraging, and cover habitats; reduction in available water for consumption; increased animal displacement and loss; reduction in prey availability; reduction in the overall biological diversity; possible genetic isolation; a reduction in the regional carrying capacity for terrestrial wildlife; and possible population declines, depending on the level of effects and the relative species' sensitivity. Assuming that these limited riparian communities are currently at their respective carrying capacities, individuals that are displaced into adjacent communities may be lost from the population, concentrating the remaining animals within smaller habitat areas. Incremental habitat loss would affect a variety of big game, upland game birds, waterfowl, shorebirds, raptors, songbirds, nongame mammals, area reptiles, and amphibians. The recovery of ground water and surface water sources would be gradual.

The reduction or loss of existing water sources could impact big game use and movements. The greatest impacts to mule deer from cumulative drawdown would be a reduction or loss of available water on important transitional ranges and a small portion of winter ranges. Since a small number of deer also use these winter and transitional ranges during the summer, water availability for mule deer could be affected in some areas year-round. Pronghorn ranges that may be affected by the cumulative loss or reduction of perennial water sources would encompass portions of summer, winter, and transitional ranges. Effects to available water would incrementally reduce the range's carrying capacity, displacing deer and pronghorn into adjacent ranges that may not support additional herd numbers. Relative to mine discharges, spring runoff coupled with water discharged from mining activities in Maggie Creek could impede deer and pronghorn movements between seasonal ranges. Only a small portion of bighorn sheep range would likely be affected from cumulative ground water drawdown. The areas potentially impacted by drawdown intersect a small area of yearlong range for bighorn sheep.

A reduction in the riparian community would ultimately affect the amount of nesting habitat for mourning doves and both potential brooding and foraging habitat for doves, sage grouse, and chukar. A decline in surface water availability would result in incremental habitat loss and displacement of individuals. Displacement could result in the loss of these individuals, assuming that adjacent communities are currently at their respective carrying capacities. A reduction in riparian vegetation also could be a limiting factor in brood rearing during the later summer when food sources, such as upland forbs, may decline due to dry conditions. Sage grouse are discussed in Section 5.6.1 for special status species.

Water birds associated with the larger spring sites in the foothill regions of the cumulative assessment area and the perennial portions of streams that support adequate riparian habitat and pools for foraging and cover may be affected by cumulative ground water drawdown. The long-term reduction or loss of available surface water and associated emergent plants in these naturally occurring wetland areas currently used by water birds would result in the displacement or loss of these birds.

The eventual reduction in flows within the three artificially created wetlands in Boulder Valley would result in a transition back into an upland plant community. It is anticipated that the number and species of water birds that use these artificial wetland communities would decline, particularly as the drier, more upland habitats began to re-establish in the valley. Based on current observations, it appears that saturated soils are increasing the leaching of minerals and salts into the soil surface and subsurface layers. The eventual transition to a plant community of more salt-tolerant species would result in changing wildlife composition for this area of Boulder Valley in the long term.

Potential long-term impacts to raptor species could include loss of potential nesting, roosting, and foraging habitat along the perennial drainages and at the seeps and springs affected by cumulative ground water drawdown. These losses would result from an incremental reduction in available habitat for both resident and migratory raptor species. The reduction in riparian-dependent prey species within the area

potentially affected by drawdown could possibly force birds to forage more within the upland habitats, which are not as diverse as the riparian communities. The habitat carrying capacity for raptors also would be reduced by the incremental loss of available nest and roost sites. Some raptors are closely associated with riparian habitats large enough to support trees and increased shrub density. Other species may use these trees for roosting only, but the cumulative drawdown area has limited vertical diversity in plant structure. Therefore, these roost sites are important, particularly for hunting activity.

The potential short- and long-term effects to both resident and migratory songbird species (including neotropical migrants) from cumulative ground water drawdown would parallel those discussed for upland game bird and nongame raptor species. Those songbirds that generally depend on open water and riparian habitats for breeding, foraging, or resting during migration would be the most affected. The incremental loss of riparian or emergent habitats would result in bird displacement and possible reduction in local avian population numbers. Migrant songbirds also may be displaced or otherwise affected by a reduction in riparian habitat. The potential for population-level impacts to occur from cumulative ground water drawdown would depend on the relative species' sensitivity, rarity, and habitat associations.

5.4.2 Humboldt River

Water discharges into the Humboldt River would result in a net increase in water, even with additional water use by existing water rights holders for irrigation purposes. A net increase in flows within the river system would increase the overall water availability for consumption for a variety of wildlife species including mule deer, waterfowl, shorebirds, songbirds, raptors, beaver, river otter, and other terrestrial species that are closely associated with these river communities. Increased flows may better support existing plant communities of willow, wild rose, cottonwoods, and emergent vegetation (e.g., bulrush, cattails) immediately adjacent to the river channel, particularly during the low-flow periods. Additional water levels along existing river meanders and old oxbows that currently do not receive sufficient water during high-flow periods could help to

establish on-channel ponds and support valuable riparian or wetland vegetation which provides important nesting, brooding, foraging, and resting habitat for many terrestrial wildlife species. These potential short-term effects would be most apparent during the low-flow period (October through February). Potential effects from seasonal flooding would include a possible loss of available nesting and foraging habitat for some species; however, this impact would be offset by the creation and enhancement of the backwater and slough areas along the river corridor. Increased annual flows may result in additional open water during the winter season, consequently improving foraging opportunities for species such as wintering bald eagles.

Although cumulative ground water drawdown may eventually reduce the Humboldt River baseflow after the mines' dewatering discharges cease, the mine-induced drawdown from the Goldstrike Mine is not predicted to contribute to the potential reduction in the river's baseflow.

Temporary increases in flows into the Humboldt Sink (including the Humboldt Wildlife Management Area) would improve breeding, foraging, and resting opportunities for resident and migratory waterfowl and shorebird species in the short term. In turn, the improved habitat conditions for these species would increase the relative prey availability for area predators. The dynamic wetland system of the Humboldt Sink is characterized by both wet and dry cycles. Additional water flowing into the Humboldt Sink and possibly the Carson Sink would provide additional habitat for wildlife. However, inundation of some habitats also would temporarily reduce the amount of available nesting habitat for some shorebird species, such as the American avocet, black-necked stilt, and other species that nest either on emergent vegetation or along the margins of wetland communities. This potential loss of available nesting habitat for certain bird species would be expected to be short-term, since the water levels would fluctuate and emergent vegetation would re-establish along the wetland borders.

Possible exposure risks of avian and mammalian wildlife species to metals and other constituents would be similar to levels recorded for premining conditions. These potential risks are anticipated

to be minimal. However, the dynamic nature of the Humboldt Sink's water system, influence of upstream water demands, fluctuations in water levels, bioaccumulation factors for some metals, and a number of environmental variables (e.g., wind deposition of salts) make it difficult to predict future long-term exposure risks to the biota.

5.4.3 Proposed Action and No Action Alternative

The cumulative impacts to terrestrial wildlife species from implementation of the Proposed Action would be limited to the short-term, incremental disturbance of the sagebrush/grassland community within Boulder Valley. This disturbance would result in short-term animal displacement and reduction in potential habitat for the upland species that typically occupy this habitat type in conjunction with other surface disturbances caused by mining activities, livestock grazing, and agricultural operations in the valley. However, the temporary and limited nature of the surface disturbance caused by the Proposed Action would be expected to be minimal, based on Barrick's proposed reclamation. No cumulative impacts to terrestrial wildlife from the No Action Alternative would be anticipated.

5.5 Aquatic Resources

5.5.1 Mine Dewatering and Localized Water Management Activities

Cumulative impacts predicted for aquatic resources are based on the results of cumulative hydrologic modeling analyses. Mine dewatering from the cumulative project operations could reduce water levels or flows in some springs and perennial reaches within the Maggie Creek, Susie Creek, Marys Creek, Boulder Creek, and Rock Creek drainages. However, the ground water analyses predicted that the Goldstrike Mine would contribute to potential cumulative flow reductions in the Boulder Creek drainage, upper Antelope Creek, and lower Rock Creek (see Section 5.2.1.1, Impacts to Ground Water Levels). It is important to note that the model-predicted surface water reductions are uncertain. If any perennial streamflows are decreased, the effect

on the aquatic resources would be a reduction of the associated aquatic habitats. These habitats would support periphyton and invertebrates and, depending on where they occur, could support Lahontan cutthroat trout (see Section 5.6.2) and other native fish species. Water level reductions in springs would affect periphyton, macroinvertebrates, and native fish species (if present). Habitat reductions would likely result in decreased numbers in these communities. If stream segments become dry as a result of reduced flows, aquatic habitat and associated biota would be eliminated. Drawdown of the water table would continue to expand and reach a maximum at approximately 100 to 170 years during the postmining period. Afterward, there would be a gradual recovery of the aquifer and associated surface waters.

Any surface water impacts on the eastern side of the Tuscarora Mountains would likely occur in water bodies located at lower elevations; these lower elevation waters are likely connected to the regional aquifer and could be affected by the dewatering activities. The higher elevation waters are thought to be isolated from the deep aquifer that is being affected. As a result, these higher elevational waters (and their associated aquatic communities) are not predicted to be impacted by the dewatering activities.

5.5.2 Humboldt River

The effects of flow increases would affect aquatic communities in the Humboldt River. Discharges to the river would increase the habitat for fish, macroinvertebrates, and periphyton. However, the possible reduction of shallow pools and braided channels could adversely affect the development of young fish. Increased flows also could result in fish composition changes, as introduced species would be able to disperse and utilize wider areas of the river and likely compete with native species. Overall, the effects of increased flows on water quality conditions would be minor. Water quality analyses indicated that dissolved arsenic, boron, and fluoride loads could increase in the Humboldt Sink. It is possible that metals could increase in sediments, but data are not available to quantify the potential changes. It is possible that increased sediment levels may affect aquatic biota in sections of the river near the Barrick outfall and Comus gage.

The Goldstrike Mine would not contribute to potential flow reductions in the Humboldt River during the postmining period. Therefore, no cumulative effects would occur for aquatic communities during postmining.

5.5.3 Proposed Action and No Action Alternative

No cumulative impacts to aquatic resources would be associated with the Proposed Action or the No Action Alternative.

5.6 Threatened, Endangered, Candidate, and Sensitive Species

5.6.1 Terrestrial Species

Potential cumulative impacts to the special status species identified for the cumulative assessment area from the mines' dewatering activities would parallel the impacts discussed for terrestrial and aquatic wildlife resources (Sections 5.4 and 5.5), encompassing habitat loss, increased displacement, loss of individuals, reduced prey availability, reduced diversity, possible genetic isolation, and potential population declines, depending on the extent of effects, whether a species is present, and the relative species' sensitivity. The potential impacts to each species as a result of the cumulative dewatering and water management activities are discussed below.

Potential exposure to constituents of concern at the Humboldt Sink parallel the risks discussed for general wildlife species, if any of the following special status species that may occur in or near the Humboldt Sink were present: the Preble's shrew, six sensitive bat species identified for the projects, bald eagle, golden eagle, northern goshawk, Swanson's hawk, ferruginous hawk, osprey, American white pelican, white-faced ibis, and black tern. It has been estimated that the possible exposure risks to metals and other constituents would be similar or the same as those for premining conditions. However, a number of both environmental and man-induced variables make it difficult to predict future long-term exposure risks.

The extent of available surface water and riparian habitats could be reduced within the cumulative assessment area, encompassing 18 acres of riparian and wetland habitats associated with isolated springs and seeps and 600 acres of habitat along perennial stream reaches encompassing upper and lower Maggie Creek, lower Susie Creek, Marys Creek, Boulder Creek, and lower Rock Creek.

The potential cumulative long-term loss of some seeps, springs, and stream reaches within the areas of potential impact to perennial surface waters could reduce the amount of potentially suitable habitat for the Preble's shrew. It is anticipated that increased flows in the Humboldt River and Humboldt Sink would provide additional water to support existing riparian and wetland communities during the mines' discharge period, which would provide additional potentially suitable habitat for this shrew species.

The potential reduction or loss of perennial surface water resources and surrounding riparian vegetation as a result of cumulative ground water drawdown could affect the six special status bat species (including the two subspecies of the Townsend's big-eared bat), incrementally reducing the amount of suitable foraging habitat for a number of these bat species. However, the vegetation density relative to the amount of open water combined with the proximity of possible foraging areas to occupied bat roosts would determine overall habitat values for bats and the extent of anticipated habitat losses or reduction in foraging opportunities. No impacts to bat hibernacula or other communal roosts would be anticipated, since it is assumed that these larger roost sites occur in caves, buildings, or large rock outcrops. Increased flows along the Humboldt River and Humboldt Sink would create additional foraging areas for bats, in the form of increased surface water area and improved riparian habitats.

The cumulative reduction in perennial surface water within the regional hydrologic study area would incrementally reduce the potential amount of available foraging habitat for wintering and migrating bald eagles. However, potential habitat effects would be minimized, based on the low number of wintering eagles that typically occur in the area and the use of both open water areas

and upland habitats for foraging. In addition, no drawdown impacts are anticipated for the Willow Creek Reservoir, a prominent site for eagles, and there are no known communal or historic roost sites within the study area. Potential effects to bald eagles that occur along the Humboldt River and Humboldt Sink during the mines' water discharges would parallel the effects discussed for general wildlife resources (Section 5.4). Increased water levels would be most apparent during the low-flow periods, resulting in more open water (less freezing) during the late fall and winter and a greater prey abundance.

Potential cumulative impacts to the golden eagle that could occur from the reduction or loss of riparian or wet meadow habitat types would be limited to an incremental reduction in potential foraging areas, if available surface water and associated riparian vegetation were affected by long-term ground water drawdown. However, this raptor predominantly nests and forages in drier, upland areas, and use of riparian drainages and wet meadow areas would be sporadic. An overall increase in water availability and maintenance or enhancement of riparian vegetation from increased water levels in the Humboldt River and in the Humboldt Sink would result in an associated increase in small mammal populations, incrementally increasing the quality of foraging habitat and opportunities.

Potential cumulative long-term effects to goshawks could result from reduction or loss of riparian habitats associated with perennial water sources at the higher elevations within the cumulative assessment area. However, the majority of these high-elevational springs and streams would not be impacted. Impacts to nesting and foraging goshawks would be limited to perennial water sources that support suitable trees for goshawk nest sites and sufficient vegetation for the smaller birds and small mammals that comprise this accipiters primary prey species. The potential effects from changing flows in the Humboldt River and Humboldt Sink would only apply to wintering goshawks, since the Humboldt River Valley occurs at lower elevations than those typically occupied by nesting goshawks.

The likelihood of Swainson's hawks nesting and foraging within the cumulative assessment area is

low, based on this species' current distribution in northern Nevada. Since this hawk species may occupy both upland and riparian areas for nesting and foraging, a potential reduction in available water and/or riparian vegetation could incrementally impact this species' nesting sites and foraging areas. A reduction in potential prey abundance (from invertebrates to small vertebrates) may affect this species' distribution and habitat use in northern Nevada, if present. Increased water levels in the Humboldt River and Humboldt Sink and maintenance or enhancement of associated riparian habitats could result in a correlated increase in potential prey species for both breeding and migrating Swainson's hawks.

A cumulative long-term reduction or loss of riparian habitats may indirectly affect the ferruginous hawk. The success of nesting raptors is often closely associated with the available prey base and relative prey densities, and prey availability is particularly important for nesting ferruginous hawks. Also, since concentrations of ferruginous hawks may use wet meadows as staging areas prior to fall migration, prey abundance in these wet meadow habitat types may be important to both migrating and nesting birds. Reduction or loss of wet meadow or riparian habitats from the cumulative drawdown effects could remove habitats for suitable prey, thereby reducing prey abundance and possibly affecting subsequent ferruginous hawk nesting success. Increasing flows within the Humboldt River and Humboldt Sink may increase prey abundance (small mammals commonly occupying wet meadow or mesic habitats) for ferruginous hawks.

No cumulative impacts to the osprey would be anticipated from the potential long-term reduction in available surface water seeps, springs, or small streams throughout the cumulative assessment area, since this rare migrant generally is associated with large reservoirs, lakes, and rivers. As discussed for the bald eagle, no effects to Willow Creek Reservoir are expected, and the possibility of individual migrating osprey foraging along the smaller creeks or springs is low. The potential increase in available water in the Humboldt River during the mines' discharge period may result in increased foraging opportunities for migrating individuals of this primarily fish-eating species.

Based on the burrowing owl's known habitat associations, it is assumed that breeding adults and young predominantly occupy dry, upland communities. However, since mesic and riparian habitats often provide a greater diversity and abundance of terrestrial invertebrates, it is feasible that adult owls would forage within these areas, particularly during the brood-rearing period. No cumulative impacts to this species' dry, upland nesting habitats would be anticipated. Potential impacts to the burrowing owl from increased water levels in the Humboldt River would be expected to be limited to an incremental increase in possible foraging habitat, though use of the river corridor likely would be sporadic and isolated.

A potential cumulative reduction in naturally occurring seeps, springs, and perennial stream reaches and their associated riparian and mesic communities could ultimately affect the amount of potential brooding and foraging habitat for sage grouse. This incremental habitat loss would be long-term, and it is assumed that the birds that are closely associated with these habitat types would be displaced or lost. In the event that perennial flows were reduced, the riparian vegetation would likely decrease, reducing the vegetative structure, composition, and diversity. As an aid in characterizing the overall distribution and concentration of lek sites, a total of 14 historic leks were documented in the cumulative drawdown area. Of these 14 leks, 11 are located in areas where perennial surface waters potentially could be affected. An additional 3 leks have been documented within 2 miles of these perennial waters, and another 5 leks are within 2 miles of the cumulative drawdown boundary.

No direct impacts to active or potential lek sites would be anticipated, since leks generally occur in more upland communities (although they are often adjacent to intermittent or perennial drainages). However, there is a potential that nesting and brood-rearing areas could be affected in riparian, wetland, and mesic habitats that could be impacted by cumulative ground water drawdown, particularly in the mid- to late summer, as the upland forbs desiccate and the broods depend more on the mesic and riparian habitats. Because these brood-rearing areas could be located several miles from leks and nesting areas within the drawdown area, it is

difficult to quantify the amount of habitat that could be affected. However, it can be stated that the loss of riparian, wetland, or mesic habitats due to drawdown in these areas would reduce the amount of possible nesting and brood-rearing habitat available, altering sage grouse distribution during summer and autumn and possibly reducing the total sage grouse population.

As discussed for the osprey and bald eagle, no impacts to large bodies of water (e.g., Willow Creek Reservoir) are currently anticipated that could support foraging American white pelicans. Since this species is closely associated with lakes or ponds, no cumulative impacts to migrating pelicans would be anticipated from future changes in water levels or riparian habitats in the mine areas or along the Humboldt River.

If present within the cumulative assessment area, individual white-faced ibis and black tern would likely use the larger spring sites in the foothills region of the mountain ranges and the perennial portions of streams that support adequate riparian habitat and pools for foraging and cover. The cumulative reduction or loss of available surface water and associated emergent plants in these naturally occurring wetland areas would result in the displacement or loss of breeding or foraging; however, no population-level impacts would be anticipated. As the mine discharges diminish in the future, the artificially created wetlands in Boulder Valley would be reduced, as well. The level of available surface water, in addition to the associated riparian and wetland vegetation, would slowly decline, with the drier, more upland communities becoming re-established. However, it presently appears that previously saturated soils have increased soil leaching of salts and minerals. This leaching process would ultimately result in a transition of the present plant communities to a community that supports more salt-tolerant plants. This transition would result in both decreased plant and wildlife species diversity. At this time, the dry alkaline soils and vegetation would not be suitable for use by either the white-faced ibis or black tern. Increased flows in the Humboldt River and in the Humboldt Sink during the mines' discharges would result in an increase in potentially suitable habitat for these two water birds.

Because the Nevada viceroy is associated with willows below 6,000 feet elevation, cumulative surface water reductions that would affect the maintenance of willow communities would reduce the amount and quality of habitat for this species. Therefore, a reduction in surface water from drawdown may reduce willow development, which would affect Nevada viceroy habitat. Increased flows in the Humboldt River due to mine-water discharges could increase riparian habitat (and associated Nevada viceroy habitat) in the short term during mine discharge.

Cumulative impacts to Lewis buckwheat are not anticipated as a result of ground water drawdown since this species is associated with upland habitats and is dependent on seasonal precipitation.

5.6.2 Aquatic Species

Hydrologic modeling predicts cumulative ground water drawdown in areas where surface water flows (and associated LCT habitat) could be reduced, including the lower sections of Little Jack, Coyote, and Beaver creeks (Figure 5-5). However, the ground water drawdown associated with Goldstrike Mine is not predicted to contribute to potential flow reductions in these stream sections or other surface waters occupied by LCT in the Maggie Creek drainage. In addition, the Goldstrike Mine is not predicted to contribute to flow reductions in Susie Creek, which has been identified as a potential LCT re-introduction stream (Coffin and Cowan 1995).

The Goldstrike Mine may contribute to flow reductions in lower Rock Creek, where California floaters have been found. This project is not predicted to contribute to flow reductions in other stream segments in the Maggie Creek drainage where California floater have been collected. Impacts in lower Rock Creek would depend on the amount of surface water reduction and could range from slight reduction to complete elimination of the California floater habitat in this stream segment.

Springsnail populations are known to occur at six springs in upper Antelope Creek, one spring in upper Willow Creek, Warm Spring in Marys Creek subbasin, and Warm Billy Spring and Rattlesnake Spring in Boulder Creek subbasin.

No populations have been found in the Maggie Creek subbasin, or the remaining portions of the cumulative assessment area. Surface waters associated with the upper Willow Creek, Warm Billy Spring, and Rattlesnake Spring would not likely be affected; however, the upper Antelope Creek and Warm Spring populations are located within an area predicted to potentially have surface water impacts. If substantial water level reductions occur in these springs, springsnail populations could be affected. If the springs were permanently dewatered, the springsnail populations in these springs would be lost.

The Goldstrike Mine also could contribute to flow reductions in upper Antelope Creek, which represents potential habitat for spotted frog. This project would not contribute to flow reductions at sites in the Maggie Creek drainage where spotted frog have been collected. Surface water impacts in upper Antelope Creek could range from a slight reduction in habitat quality to elimination of the spotted frog habitat within the affected area. Potential reduction in spotted frog numbers could contribute to a proposal to list this species.

5.7 Grazing Management

Portions of 16 grazing allotments are located in the cumulative assessment area, including the Squaw Valley, Tuscarora/Quarter Circle S, Twenty-five, Boulder Field, T Lazy S, Hadley, Carlin Canyon, Carlin Field, McKinley, Blue Basin, Lone Mountain, Adobe, Adobe Hills, Marys Mountain, Palisade, and Horseshoe allotments. For most of these allotments, public land provides 36 to 86 percent of the livestock carrying capacity. The Blue Basin, McKinley FFR, and Carlin Canyon allotments consist primarily of private lands with smaller parcels of public land.

Some of the water produced from Barrick's dewatering activities is used for irrigation and livestock watering in Boulder Valley. Water used to irrigate approximately 10,000 acres of land for the production of alfalfa, barley, and introduced pasture grasses and provide water to grazing livestock is conveyed via pipelines (Gralian 1998).

Range improvements within the cumulative assessment area include livestock water sources (e.g., improved springs, stock wells, stock ponds,

water pipelines and troughs), fences, seeded rangeland, and cattle guards. A livestock exclusion fence has been constructed around the wetland area at Green, Knob, and Sand Dune springs in Boulder Valley to prevent grazing of approximately 1,000 acres of riparian vegetation. Water sources are critical to grazing operations since livestock require water daily and the location of these water sources directly affects the distribution of livestock within an allotment.

5.7.1 Mine Dewatering and Localized Water Management Activities

Ground water drawdown resulting from mine-related dewatering activities may affect various water sources used by livestock including improved springs, springs, seeps, and perennial stream reaches. Impacts are anticipated only for those water sources that are hydrologically connected with the regional ground water system. No impacts to water sources that obtain water from perched or localized aquifers are anticipated. Only stock ponds associated with seeps or springs connected to the regional ground water system potentially could be affected. Water troughs and pipelines associated with improved springs or stock wells also could be affected.

Impacts that may occur as a result of ground water drawdown include reduced flow or complete cessation of flow from water sources. The long-term loss of water sources would result in the reduction or loss of permitted active grazing use within a grazing allotment if alternative water sources are not present within the vicinity of the affected water sources or if lost water sources are not mitigated. In pastures where alternative water sources exist, the degree of impact on livestock distribution and stocking levels would depend on terrain, distance between water sources, timing of livestock use, and class of livestock. Drawdown impacts could be localized to water sources within one or several pastures within an allotment. The loss of the majority or all water sources within these pastures would likely affect livestock distribution, forage utilization, and grazing management operations.

Reductions in the number and distribution of water sources and reductions in permitted active

grazing use would affect grazing permittees by forcing them to find additional rangeland for livestock or to reduce their herd size within the affected pasture or allotment to appropriate stocking levels as determined by the BLM. Permittees would likely try to find additional pasture to accommodate their grazing operations, otherwise the permittees would likely be subjected to economic losses if mitigation does not occur. Currently, all allotments and active permitted grazing use within the Elko District are adjudicated and the option of finding alternative rangeland for grazing is severely limited due to the limited amount of private land in the area.

Specific impacts to natural perennial water sources within the cumulative assessment area are described in Section 5.2.1.2. Some of the water-related range improvements in the Twenty-five, T Lazy S, Hadley, Carlin Field, McKinley, and Marys Mountain allotments potentially could be affected by ground water drawdown. Water-related range improvements in the Squaw Valley, Tuscarora/Quarter Circle S, Boulder Field, Carlin Canyon, Blue Basin, Lone Mountain, Adobe, Adobe Hills, Palisade, or Horseshoe allotments have a low probability of being affected by ground water drawdown.

5.7.1.1 Twenty-five Allotment

Ten water-related range improvements, including six water troughs, one water pipeline, and three improved springs, potentially could be affected by cumulative ground water drawdown. Seven of the 10 improvements are located in the Willow Creek Seeding pasture, and the remaining improvements are located in the Santa Reina pasture. The potential long-term loss of all of the improvements in the Willow Creek Seeding pasture could result in the potential long-term loss of permitted active grazing use within the pasture. This pasture does not include any additional water sources such as perennial creeks or reservoirs. The potential long-term loss of improvements in the northern portion of the Santa Reina pasture may result in the long-term loss of permitted active grazing use or affect forage utilization. The northern portion of this pasture does not include perennial water sources. Perennial reaches of Squaw and North Antelope creeks would be alternative water sources for livestock in the southern portion of the pasture. A

portion of Boulder Creek, located in the western portion of the Boulder Creek pasture, could potentially be affected by groundwater drawdown.

5.7.1.2 T Lazy S Allotment

The majority of water-related range improvements and natural perennial water sources could be affected by cumulative ground water drawdown. Sixteen water-related range improvements, including four stockwater ponds, two water pipelines, three stock wells, and seven improved springs, could be affected by ground water drawdown. One water pipeline is located in the Betze-Post Pit area, which is closed to grazing. Fifteen improvements are located in the Central Native pasture and could be affected by ground water drawdown. The potential long-term loss of water sources could result in the long-term loss of permitted active grazing use within the pasture or affect forage utilization since additional water sources, such as perennial creeks or reservoirs, are not available for livestock.

Some seeps and springs within the Lower Northern Native, Upper Northern Native, Bob's Flat, and Lynn Creek seeding pastures also could be affected by cumulative ground water drawdown. Isolated seeps and springs in the higher elevations of the Tuscarora Mountains would likely be unaffected by ground water drawdown and would provide natural water sources for livestock in the central portion of the allotment.

5.7.1.3 Hadley Allotment

Nine water-related range improvements, including five stock wells, two improved springs, one water pipeline, and one trough and pipeline, could be affected by cumulative ground water drawdown. All of these improvements are located in the South Hadley No. 2 pasture. If the water level were lowered beyond the well intake zone, or below the pump setting, the stock wells would no longer provide water for livestock use unless the pump setting or wells were deepened. The potential long-term loss of these water sources would result in the long-term loss of permitted active grazing use or affect forage utilization within the pasture. One improved spring and one stockwater pond would be available for livestock use in the South Hadley No. 2 pasture if the other

water sources are not available. Alternative water sources, such as East Cottonwood Creek and Maggie Reservoir, may be available for livestock use. The perennial reach of East Cottonwood Creek could be reduced by ground water drawdown.

5.7.1.4 Carlin Field Allotment

Three water-related range improvements, including one improved spring, one stock well, and one water pipeline, could be affected by cumulative ground water drawdown. The stock well is located in the North Carlin Field pasture, and an improved spring and a water pipeline are located in the South Carlin Field pasture. The stock well is located inside the area that could be affected by groundwater drawdown; therefore, the well may be affected as discussed previously for wells in the Hadley Allotment. Other water sources (i.e., improved springs, troughs, and a stock well) within the North Carlin Field pasture would be available for livestock use since they would not be affected by ground water drawdown. The potential long-term loss of an improved spring and a water pipeline within the Carlin Field South pasture would not likely affect the permitted active grazing use or forage utilization within the pasture. One improved spring would likely be unaffected by ground water drawdown and would likely provide an adequate supply of water within the small pasture.

5.7.1.5 McKinley Allotment

Three water-related range improvements, including one stock well and two troughs, could be affected by cumulative ground water drawdown. All of these improvements are located in the South pasture. The potential long-term loss of this water source may result in the potential long-term loss of permitted active grazing use or affect forage utilization within the pasture.

5.7.1.6 Marys Mountain Allotment

Seven water-related range improvements, including three improved springs, three water pipelines, and one natural spring, could be affected by cumulative ground water drawdown. The potential long-term loss of these water sources may result in the potential long-term loss of permitted active grazing use or affect forage

utilization within the pasture. Additional water sources within the allotment, such as Marys and James creeks, may be available for livestock use.

5.7.2 Humboldt River

During the period of mine dewatering discharge, slightly increased water levels within the Humboldt River floodplain would likely increase the areal extent of herbaceous wetlands immediately adjacent to the river channel. Forage production and the carrying capacity of these narrow areas also would likely increase temporarily. Increased water levels also may increase the availability of water for livestock use. Discharge waters reaching the Humboldt and Carson sinks would not affect grazing management since livestock grazing is not allowed within these areas.

Although cumulative ground water drawdown may eventually reduce the Humboldt River baseflow after the mines' dewatering discharges cease, the mine-induced drawdown from the Goldstrike Mine is not predicted to contribute to the potential reduction in the river's baseflow.

5.7.3 Proposed Action and No Action Alternative

The maximum disturbance of 18 acres associated with the Proposed Action would have minimal impacts on grazing. Therefore, no cumulative grazing impacts are anticipated from the Proposed Action or the No Action Alternative.

5.8 Socioeconomics

This section provides a qualitative evaluation of potential cumulative effects to socioeconomics from existing and proposed mines within the study area. Because of the complex interrelationships of surface and ground water variables, and soil composition, geologic, climatological, and geochemical variables, all of which are influential on hydrologic impacts, it is not possible, with any degree of certainty, to identify the extent to which social and economic impacts may occur. However, more than 50 mitigation measures have been proposed by Barrick and Newmont as part of their plans of operations. These mitigation measures,

discussed on pages 1-9 through 1-12 of the CIA report (BLM 2000b), have been designed to mitigate environmental and economic impacts that may occur. It is, therefore, not expected that any economic losses will be sustained. Potential economic impacts have been identified and are addressed as part of this analysis as follows:

- Effects on water users and water-dependent natural resources due to reduction in surface water quantity and ground water quantity and quality
- Impacts to irrigators as a result of increased flow in the Humboldt River during mine discharge, and decreased flow in the river after cessation of mine discharge
- Impacts to water users and water-dependent natural resources due to potential increases in flooding, erosion, and sedimentation associated with water management activities
- Effects on recreational opportunities due to changes to the hydrologic system; it is assumed that adverse and beneficial impacts on wildlife and fisheries may have socioeconomic impacts related to hunting and fishing opportunities

The affected environment associated with socioeconomic-related cumulative impacts includes the mine dewatering area in the Carlin Trend and the Humboldt River basin that would be affected by mine discharge and other activities that discharge and/or consume water.

The study area for mine dewatering encompasses the six designated ground water basins shown in Figure 1-6, including the city of Carlin and the communities of Palisade and Dunphy. Socioeconomic concerns in this area include lowered water levels in wells, reduced flow in springs (livestock and wildlife impacts), reduced streamflow (irrigation and livestock impacts), and development of sinkholes (possible damage to private property and/or natural resources).

The regional study area for the Humboldt River basin extends from the Carlin gage on the Humboldt River downstream to the Humboldt Sink (Figure 1-6). This area potentially could be

affected by discharge and consumption of water due to mining and other activities (e.g., irrigation, municipal, industrial, and domestic uses). Socioeconomic conditions in this area related to water use, consumption, and discharge are considered for the cumulative analysis.

5.8.1 Mine Dewatering and Localized Water Management Activities

Potential socioeconomic impacts that may occur in the mine dewatering area resulting from drawdown of ground water in the Carlin Trend are described in this section. Effects on ground water resources are described in Section 3.2.

5.8.1.1 Lowered Water Levels in Wells

Potential socioeconomic impacts associated with lowering the water level in a given well may include: increased pumping costs due to increased pumping head; need to lower the pump in the well; purchasing a new pump; and drilling a new deeper well. Specific impacts to individual wells would depend on well location, completion, depth, yield, pump type and setting depth, and water pumping levels.

Socioeconomic impacts resulting from lowered ground water levels could affect a variety of water uses, including domestic, industrial, commercial, irrigation, and stock water. Sections 5.2.1.3 and 5.2.1.4 identifies the number of water rights by category of use and potential cumulative impacts to these rights. If stock water availability were reduced, permitted active grazing use (i.e., AUMs) within a grazing allotment could be reduced. Grazing permittees would likely try to find additional pasture; however, because grazing allotments are fully allocated in this area, permittees would likely reduce livestock numbers with a resultant loss in income and associated impacts on the local economy (see Section 5.7, Grazing Management).

5.8.1.2 Reduced Flow in Springs

As described in Section 5.2.1, cumulative dewatering activity could impact flow from springs hydraulically connected to the regional ground water system within the ground water drawdown area. Springs with reduced flow may affect some

water sources for livestock and wildlife, resulting in socioeconomic impacts to affected livestock owners and the state's wildlife resources (e.g., big game, upland game birds, raptors, and fishery resources). Hunting and fishing opportunities could be reduced in some of the impacted areas. Species of special concern (terrestrial wildlife and aquatic life) that potentially could be affected, including the Lahontan cutthroat trout, may require additional resources by wildlife agencies to monitor and evaluate the status of these species. Springs that support domestic water supply to the city of Carlin (i.e., Carlin Cold Spring in the Marys Creek drainage) also could be affected by dewatering in the Carlin Trend. Newmont would replace the drinking water supply for the city of Carlin to offset any impacts to the Carlin Cold Spring from dewatering activities (SOAP Final EIS, Appendix A – Mitigation Plan; BLM 1993d). Therefore, there would be no measurable socioeconomic impact to the city of Carlin's water supply as a result of dewatering activities.

5.8.1.3 Reduced Streamflow

Numerical model simulations used to predict changes in stream baseflow as a result of cumulative ground water drawdown show that streams in the vicinity of the Carlin Trend could decline in flow during and after cessation of mining (Figure 5-5), including Rock Creek, Boulder Creek, Maggie Creek, Marys Creek, and Susie Creek. The predicted reductions in baseflows in these streams and the baseflow predictions over time are described in Section 5.2.1. The maximum changes in flow rates are predicted to occur after cessation of dewatering and with the exception of lower Maggie Creek, to be followed by a gradual return to approximate premine conditions. Potential impacts to Humboldt River flow are discussed in Section 5.2.2.

Section 5.2.1.4 describes the surface water rights that have been identified within the potential cumulative ground water drawdown area (Figure 3-21 and Table 3-17), including the water rights that are for irrigation or livestock watering. Section 5.2.1.4 indicates that some of these surface water rights potentially could be affected by ground water drawdown; therefore, socioeconomic impacts could occur from reduced

streamflow for these designated uses, including costs to replace irrigation and livestock watering sources.

5.8.1.4 Geology and Minerals

Some areas of sinkhole development have occurred in the Carlin Trend area that may be attributed to mine dewatering. Sinkholes are most likely to occur in areas where carbonate rocks are at or near the ground surface. Areas potentially susceptible to sinkhole development have been delineated in the Carlin Trend study area (see Section 5.1). Most of these potential sinkhole development areas are located between the Goldstrike and Gold Quarry mines. If any sinkholes develop as a result of mine dewatering, no cumulative socioeconomic impacts are expected, unless damage to private property and/or natural resources, as identified in Section 5.1, would require some form of corrective action.

5.8.2 Humboldt River

This section describes potential socioeconomic impacts that may occur in the Humboldt River basin resulting from discharges of dewatering water to the Humboldt River from the Goldstrike, Gold Quarry, Leeville, and Lone Tree mines. Based on current and proposed mining, dewatering discharges would continue until 2006, during which time flow in the Humboldt River would increase over premine conditions. After cessation of dewatering discharges, flow in the river would decline below premine conditions but would gradually recover to near premine rates; this recovery period may extend for more than 100 years.

5.8.2.1 Increased River Flow

Additional contributions to Humboldt River flows from mine dewatering discharges are discussed in Section 5.2.2. Since the Humboldt River is over-appropriated, the additional excess mine water would be a positive effect to water right holders in the basin. Storage of excess mine water in Rye Patch Reservoir could provide additional water for irrigation downstream of the reservoir. An additional 100 to 200 cfs in the Humboldt River is equivalent to approximately 6,000 to 12,000 acre-feet per month, some of

which would be available to downstream irrigators.

Higher flow in the river year-round during the period of mine dewatering also may cause increased erosion of the riverbed and banks. This erosion could encroach slightly on private property along the river. Any erosion that causes loss of land could affect current and future economic values of the land.

An additional socioeconomic impact of increased water in the Humboldt River may include limiting the ability to repair irrigation diversion structures during the low-flow periods. Irrigators typically repair these structures as needed when river flow has declined in the fall. The increased flow from mine discharges may cause more water to be in contact with the irrigation structures on a year-round basis and make it more difficult to perform the necessary repairs. If irrigation structures cannot be repaired during low-flow periods, the cost to access and repair the structures may increase.

5.8.2.2 Reduced River Flow

Based on numerical model results, the maximum predicted cumulative reduction in baseflow of the Humboldt River would occur near the end of dewatering operations. The long-term decrease in Humboldt River base flow could extend for a period of more than 100 years. As described in Section 5.2.2, mine-induced drawdown from the Goldstrike Mine is not predicted to contribute to potential reductions in Humboldt River baseflows. Therefore, the Goldstrike Mine would not contribute to potential cumulative reductions in Humboldt River baseflows.

5.8.2.3 Water Quality Impacts

As discussed in Section 5.2.2, mine discharges to the Humboldt River could increase loads and possibly concentrations of inorganic constituents in the river and Humboldt and Carson sinks. Economic conditions would not be affected by potential increased chemical loads to the Humboldt River and Humboldt Sink.

5.8.3 Proposed Action and No Action Alternative

No cumulative socioeconomic impacts are anticipated from implementation of the Proposed Action (buried pipeline) or the No Action Alternative.

5.9 Native American Religious Concerns

Past, present, and reasonably foreseeable dewatering and water management activities in the region may result in a cumulative impact to resources of importance to Native Americans. The need to consider these potential impacts is addressed in the Archaeological Resources Protection Act, the National Historic Preservation Act, the American Indian Religious Freedom Act, the Native American Graves Protection and Repatriation Act, and Executive Order 13007. BLM guidance is contained in the Native American Consultation Handbook (8160) and its supplement (8160-1).

The Elko Field office of the BLM initiated Native American consultation with regard to the cumulative dewatering assessment on October 1, 1998. BLM efforts to engage in consultation have been ongoing since that date. The consultation process was initiated with the Te-Moak Tribe, the Duck Valley Tribe, the Fort Hall Tribe, the Battle Mountain Band, the Elko Band, the Wells Band, the South Fork Band, the Western Shoshone Historic Preservation Society, and the Western Shoshone Defense Project. Letters were sent via certified mail to each tribe, band, and organization (see Appendix G of the CIA report [BLM 2000b]). Through the consultation process, the BLM requested information from the Western Shoshone about culturally important or sacred sites that may be impacted by mine dewatering within the predicted 10-foot drawdown area as depicted to the Native Americans during consultation (see Figure G-1 in Appendix G of the CIA report [BLM 2000b]).

Native Americans are concerned with the public distribution of information regarding the location and nature of many traditional places. Specific information provided to the BLM has been held as confidential. Given the sensitivity of this issue, the current analysis addresses types of resources rather than specific resources. The only exception is traditional cultural properties that are widely

known and for which information is available in the public domain.

Consultation and research conducted as a part of this assessment resulted in the identification of general issues that require consideration as part of the cumulative impact assessment. Those general issues include the following:

- Potential impacts to elements of traditional lifeways that currently occur in the assessment area need to be assessed. In particular, impacts to plant and animal species that are the subject of resource procurement activities must be identified. The Western Shoshone expressed concern with the regional decline of sage grouse habitat.
- Water is life. In acknowledgement, the Western Shoshone have expressed concern regarding impacts that would affect surface waters such as springs (hot and cold) and streams. The quality of the water is also of concern to the Western Shoshone.
- Potential impacts to National Register eligible traditional cultural properties, known or presumed Native American grave sites, and places of historical significance to Native Americans must be assessed.
- Potential impacts that would limit the ability of the Western Shoshone to maintain traditional religious practices currently conducted in the assessment area must be assessed.
- Potential impacts to natural elements that may in turn cause changes in Western Shoshone cosmology must be assessed.

It is recognized that there is no single Western Shoshone viewpoint regarding these matters (Crum 1994). Rather, a diversity of perspectives exists. Information presented herein regarding impacts to issues of Native American concern represents a composite view drawn from cited resources.

5.9.1 Impacts to Plants

As identified in Section 5.3 of this document, there are an estimated 600 acres of riparian/wetland vegetation in areas where

perennial waters could be impacted by ground water drawdown. An estimated 18 acres wetland vegetation associated with isolated springs and seeps also occur in areas where perennial waters could be impacted. Although located outside the maximum drawdown area, hydrologic modeling simulations indicate that baseflow along the lower reach of Rock Creek could decrease (see Figure 5-3); this reduction could result in the loss of some riparian vegetation currently present along this reach. Effects to riparian vegetation are predicted to reach their maximum intensity about 100 years postmining and to gradually lessen as the ground water system rebounds.

The Western Shoshone place a high degree of cultural value on plant resources. Comparisons of traditional and current plant use reveal substantial overlap. Most species used traditionally remain in use. Actions addressed by the cumulative impact analysis could result in the loss of plants that otherwise would have been available for use by Western Shoshone. Gathering practices important to the maintenance of Western Shoshone cultural traditions may be impacted. Changes in the structure of plant communities would cause disruption among spirit forces. The Western Shoshone believe that little men and plant spirits would likely leave the area, affecting the distribution and availability of other plant resources (Clemmer 1990).

5.9.2 Impacts to Animals

As noted in Section 5.4, a reduction in riparian and wetland vegetation would affect terrestrial wildlife dependent on those resources. Impacted riparian/wetland vegetation and surrounding areas would support a lower diversity and reduced number of riparian dependent wildlife species. Species that could be impacted include big game (mule deer and antelope) and upland game birds (sage grouse, mourning dove, and chukar). Raptors and songbirds could be affected, but to a lesser extent.

Animals are of particular importance to the Western Shoshone. Many species continue to be an important subsistence resource. Actions addressed by the cumulative impact analysis could impact the abundance and distribution of many animal species and their habitat. Depending on the availability of alternate habitat,

some animals could be lost from the population. Of particular concern, the ongoing regional decline of sage grouse and their habitat could be exacerbated (see Section 5.6). Sage grouse are considered sacred, and the hunting of these birds is important to the maintenance of Western Shoshone cultural identity. The continued presence and availability of sage grouse, along with that of other animal species, is important to the maintenance of Western Shoshone cultural traditions.

Also, a loss or redistribution of wildlife species would cause the disruption of spirit forces present in the area. The Western Shoshone believe that little men and animal spirits would likely move or may leave the area, affecting the distribution and availability of other game (Clemmer 1990). This may impact hunting activities important to the maintenance of cultural traditions.

5.9.3 Impacts to Water

Since "water is life," the Western Shoshone express particular concern regarding any impacts that may occur to surface waters such as springs and streams. Mine dewatering has been ongoing in the study area for some time. Monitoring conducted to-date by Newmont and Barrick is summarized in Sections 3.2.3.1 and 4.1.1 of the CIA report (BLM 2000b). Current limits of ground water drawdown and mounding are shown in Figure 5-2. These data indicate that several springs have either dried up or exhibit a reduced flow, and that along one drainage (Brush Creek) the streamflow and vegetation have been impacted (Adrian Brown Consultants, Inc. 1997, 1999). Some of these impacts may be due to mine dewatering.

Ground water modeling predictions indicate that the extent of the cone of ground water drawdown associated with the proposed mining activities would increase over time. The maximum extent of the 10-foot drawdown is predicted to occur some 100 years postmining. The maximum drawdown area is divided into areas in which perennial waters could potentially be impacted, and areas where perennial waters are less likely to be impacted (see Figure 5-5). Beaver Creek, Little Beaver Creek, Coyote Creek, Little Jack Creek, Indian Creek, Cottonwood Creek, Lynn Creek, Simon Creek, Willow Creek, Rock Creek, Boulder

Creek, Bell Creek, Brush Creek, Rodeo Creek, Upper Antelope Creek (and its tributaries), North Antelope Creek, Squaw Creek, Marys Creek, and Maggie Creek are listed as streams that could be affected. Selected creeks were analyzed to predict the maximum reduction in baseflows (see Figure 3-18 of the CIA report [BLM 2000b]). The model simulations indicate that if the drawdown cone expands to the west as predicted by the HCI model (HCI 1999a) baseflows along lower Rock Creek could be reduced. Also, some loss in flow could occur at the Carlin Springs (hot and cold). Noticeable change in the water balance are predicted to occur in the Boulder Flat and Maggie Creek hydrographic areas, and to a lesser extent in the Rock Creek hydrographic area. The Rock Creek water balance would recover by about 2061. Minor changes could occur in the Marys Creek and Susie Creek area, while no change is predicted in the Willow Creek area.

As discussed in Section 5.2.1.1, it is not possible to identify conclusively which perennial waters would or would not be impacted. Impacts to perennial waters are most likely to occur over only a portion of the maximum potential drawdown area. Areas where perennial waters may potentially be impacted by ground water drawdown are shown in Figure 5-5. Springs and seeps located in these areas could experience some reduction in flow.

Actions considered in the cumulative impact assessment would operate in compliance with provisions of the Clean Water Act. Any discharge would need to be permitted by the Nevada Bureau of Water Pollution Control. Section 5.2.2 of this document identifies potential cumulative impacts to water quality in the Humboldt Sink.

Water sources are of special importance to the Western Shoshone both for their resource and their spiritual value. The maintenance of plant and animal communities is dependent on the availability of water derived from stream, springs, and seeps. A reduction or loss of flow from streams, springs, and seeps would alter the distribution and disposition of spirit forces associated with water. Impacts to Rock Creek would be of particular concern. Maintaining a relationship with these forces is integral to the spiritual life of the Western Shoshone. A reduction or loss of these flows would cause a

disruption among spirit forces. The Western Shoshone believe that water babies, little men, and spirits found in and around the impacted water sources would likely leave. This may have an impact on the maintenance of Western Shoshone cultural traditions.

5.9.4 Impacts to Traditional Cultural Properties, Grave Sites, and Historic Sites

During the consultation process, the Western Shoshone referenced the Tosawihi Quarry and Rock Creek traditional cultural properties, and stressed the importance of continued access to these properties in the maintenance of cultural and traditional beliefs. The Western Shoshone consider information about the location of elements associated with these properties to be confidential. Of particular concern to the Western Shoshone is the lower reach of Rock Creek (that portion located south of Antelope Creek) and springs in the general vicinity of the current Hollister Mine.

The Tosawihi Quarry Traditional Cultural Property is located within the maximum extent of the 10-foot drawdown that is predicted to occur. Perennial streams, springs, and seeps present in the immediate vicinity of the Tosawihi Quarry Traditional Cultural Property appear to have a low probability of being impacted by ground water drawdown. However, areas where perennial waters may be impacted are located near the Tosawihi Quarry. These include reaches of upper Antelope Creek and its tributaries, a few isolated springs in the Willow Creek area, and, most importantly, the lower portion of North Antelope Creek. Given their location near these potentially impacted areas, impacts to springs and seeps at the Tosawihi Quarry could occur. Any such impact would most likely occur as drawdown approached its maximum areal extent (100 years postmining).

The Rock Creek Traditional Cultural Property is located just outside the outermost extent of the predicted 10-foot drawdown. Perennial streams, springs, and seeps present in the immediate vicinity of the property appear to have a low probability of being impacted by ground water drawdown. However, based on cumulative model simulations, baseflows along portions of Rock

Creek could be reduced (Figure 5-3). This could result in a concomitant reduction of riparian plant species. These impacts could occur along a portion of Rock Creek that is of greatest concern to the Western Shoshone. Such temporary impacts could occur as drawdown approached its maximum areal extent (100 years postmining).

Based on these data, it appears that some level of impact may occur to the Tosawihi Quarry and the Rock Creek traditional cultural properties. Physical impacts could take the form of reduced flows in area streams and springs, and the modification of plant and animal species dependent on those waters. These impacts could most likely occur as drawdown approached its maximum areal extent (100 years postmining). The Western Shoshone believe that spiritual impacts may occur due to the disruption of forces associated with those waters, plants, and animals and that such impacts, either physical or spiritual, could affect the ability of Western Shoshone to maintain religious, cultural, and educational traditions.

5.9.5 Impacts to Traditional Religious Practices and Cosmology

Spirits can be benevolent or malevolent, depending on how they are treated. Many Western Shoshone rituals are directed at controlling the use of power and balancing the potentially dangerous spiritual powers that pervade nature. Western Shoshone religion is focused on maintaining the integrity of power spots, maintaining the presence of little men, maintaining their relationship with the owner-spirits of plants and animals, and maintaining life-giving forces such as the sun, earth, and water. Correcting neglected or abused relationships between humans and spirits is a major aspect of Western Shoshone religion.

This cumulative impact assessment documents the extent to which ground water drawdown may affect stream, spring, and seep flows in the assessment area. It also addresses the concomitant changes that may occur to vegetation patterns and wildlife distribution. Any such changes, individually and collectively, could impact the integrity of power spots, disrupt the flow of spiritual power (*Puha*), and cause the

displacement of spirits (e.g., little men and water babies). Any such effects would have an impact on Western Shoshone spiritual life and cosmology, and may limit their potential to participate in traditional religious activities.

The Western Shoshone consider the modification of power relationships to be dangerous. Altering the intricate web of power relationships that occur over a landscape affects the basic relationship between the Western Shoshone and Mother Earth. The potential to balance malevolent powers that pervade nature becomes diminished. The very character of the spiritual realm would be modified. The potential for such an effect is of particular concern to the Western Shoshone because impacts associated with ground water drawdown would be so interwoven, and because the resultant disruption of spirit forces could occur over such a wide area.

The assessment of Native American concerns was based on two types of information. Initially, emphasis was placed on the review of existing literature. Sources reviewed included ethnographic reports and monographs that address the region and manuscripts and material on file with the BLM. The various bands of the Te-Moak Tribe of Western Shoshone, the Duck Valley Tribal Council, the Shoshone-Bannock Tribe, the Western Shoshone Defense Project, and the Western Shoshone Historic Preservation Society were contacted by the BLM.

Information derived from these sources indicates that ground water drawdown would have an effect on resources of specific concern to Native Americans. Water is central to all living and spiritual things. The Western Shoshone feel that predicted impacts to streamflows, springs, and seeps would have a particularly adverse effect. Impacts would occur to riparian communities and animals that depend on those communities. The Western Shoshone are very concerned with the direct impacts that would occur to water, plants, and animals. Of even greater concern to the Western Shoshone are the disruptions that would occur to life and spirit forces found in or associated with these waters, plants, and animals. Impacts would occur to two areas identified by BLM as traditional cultural properties. Impacts to those areas may affect the ability of

the Western Shoshone to maintain cultural traditions.

In summary, the Western Shoshone believe that ground water drawdown would have an adverse impact on both the physical and spiritual worlds. Impacts of the magnitude proposed are dangerous in that they would substantially alter the intricate web of power relationships that exist in nature and between the Western Shoshone and Mother Earth. Native American consultation is still in progress, see Section 6.4.

5.10 Cultural Resources

Potential cumulative impacts to Native American religious concerns associated with the cumulative dewatering and water management operations are discussed in Section 5.9. No additional cumulative impacts to cultural resources are anticipated, including cumulative impacts associated with the Proposed Action or the No Action Alternative.

5.11 Air Quality

No cumulative air quality impacts are anticipated. No air quality impacts are anticipated from the cumulative dewatering and water management operations. As described in Section 4.1, the impacts associated with the Proposed Action (i.e., the buried pipeline) would be limited to short-term increases in particulates during the 2-week construction period. Therefore, no cumulative impacts are anticipated from the Proposed Action or the No Action Alternative.

5.12 Topography and Soils

No cumulative impacts to topography or soils are anticipated. No topography or soils impacts are anticipated from the cumulative dewatering and water management operations. As described in Section 4.2, the impacts associated with the Proposed Action would involve a short-term effect to a maximum of 18 acres of disturbance during pipeline construction; these impacts would cease following reclamation of the right-of-way. Therefore, no cumulative impacts to topography or soils are anticipated from the Proposed Action or the No Action Alternative.

5.13 Access and Land Use

No cumulative impacts to access and land use are anticipated. No access or land use impacts are anticipated from the cumulative dewatering and water management operations. As described in Section 4.8, the impacts associated with the Proposed Action would involve a short-term effect to a maximum of 18 acres of disturbance during pipeline construction; these impacts would cease following reclamation of the right-of-way. Therefore, no cumulative impacts to access or land use are anticipated from the Proposed Action or the No Action Alternative.

5.14 Visual Resources

No cumulative visual resource impacts are anticipated. No impacts to visual resources are anticipated from the cumulative dewatering and water management operations. As described in Section 4.10, the impacts associated with the Proposed Action would involve a short-term effect during pipeline construction; these impacts would cease following reclamation of the right-of-way. Therefore, no cumulative impacts to visual resources are anticipated from the Proposed Action or the No Action Alternative.